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2008-09 ANNUAL REPORT

LOUISIANA BOR PKSFI

CENTER FOR SMART CYBER CENTRIC SENSOR

SURVEILLANCE SYSTEMS

GRANT# LEQSF (2007-12)-ENH-PKSFI-PRS-03

PI: Dr. Vir V. Phoha
Co-PIs: Dr. S. S. Iyengar, Dr. Gabrielle Allen, Dr. Peter Chen

Chair of Research and Industrial advisory Board: Les Guice

June 15, 2009

1. PERSONNEL: LIST ALL KEY PERSONNEL AND OTHER STAFF WHO PROVIDED *SIGNIFICANT* CONTRIBUTIONS TO THE PROJECT. PROVIDE INFORMATION ABOUT THE TYPES OF CONTRIBUTIONS MADE BY EACH LISTED PARTICIPANT AND CONTROLS IN PLACE TO ENSURE THAT THESE CONTRIBUTIONS ARE ADEQUATE TO THE PROJECT'S REQUIREMENTS.
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1.1. Key Personnel and Their Contributions

1.1.1. Project Team

Dr. Vir V. Phoha, (La Tech), PI; Dr. S.S. Iyengar, (LSU), Co-PI; Dr. Peter Chen, (LSU), Co-PI; Dr. Gabrielle Allen, (LSU), Co-PI; Dr. Rastko Selmic, (La Tech), Sr. Researcher; Dr. Tevfik Kosar, (LSU), Sr. Researcher; Dr. Christian Duncan, (La Tech), Sr. Researcher; Dr. Asok Ray, (Penn State University), Sr. Consultant.

1.1.2. Core Research Team

Dr. Vir V. Phoha, (LA Tech), PI; Dr. S.S. Iyengar, (LSU), Co-PI; Dr. Peter Chen, (LSU), Co-PI; Dr. Gabrielle Allen, (LSU), Co-PI; Dr. Asok Ray, (Penn State University), Sr. Consultant.

Senior Researchers: Dr. Kiran Balagani, (La Tech); Dr. Christian Duncan, (LA Tech); Dr. Jinko Kanno, (La Tech); Dr. Md Enamul Karim, (La Tech); Dr. Tevfik Kosar, (LSU); Dr. Jean Gourd, (La Tech); Dr. Nandan Parameswaran, (LSU); Dr. Rastko Selmic, (La Tech); Dr. Greg Vert, (LSU); Dr. Jian Zhang, (LSU).

1.1.3. Research Partnerships

Collectively the team and individually the investigators have produced significant research results supported by the PKSFI grant. Multidisciplinary research with other departments has precipitated collaboration. Dr. Jeff Walcyzk, Associate Professor, Department of Psychology & Behavioral Sciences at La Tech and Dr. Christie Fuller, Assistant Professor, Department of Management & Information Systems at La Tech have made significant contributions in multidisciplinary research and expressed an interest in further team support.

Over all the research team has to its credit more than 60 research papers and 2 reports of invention (see the attached document containing a list of publications). The Core Research Team has developed in infrastructure and support and is presently comprised of 15 Ph. D. Researchers. This support has created expansion in currently funded research efforts from AFRL (AIS Technology Transfer), AFOSR Cyber Security Laboratory, ONR Secure and Survivable Sensor Networks, NSF SPS and ONR Science of Autonomy. Dr. Les Guice, Dr. Md Enamul Karim, and Dr. Vir Phoha have been working with Program Manager Robert Herklotz to create a Cyberspace Research Laboratory dedicated to research and education in Cybersecurity, sensors and networks. This center will function under the project name the Cyberspace Research

Laboratory.

The Core Research Team and their students have collaboratively worked on rare and event pattern detection, online lie detection, intelligent placement of sensors, visualization of graphics, malware, and malicious executables, anomaly detection, system security, cyber forensics, sensor fusion, secure information dissemination, grid structures and computation, data placement in distributed computer systems, sensor data modeling and information theoretic analysis programming sensor networks, statistical machine learning and network security.

1.1.4. Research and Industrial Advisory Board

The Research and Industry Board (RIAB) for this project consists of key technology companies and research entities in the region, as well as major industry players from across the country. Dr. Les Guice (La Tech), is the Chair of the Research and Industrial Advisory Board and VP for Research and Development.

The RIAB will facilitate partnerships that drive the development of cyberspace products of common interest to industry and the military, and develop new relationships with leading technology companies to enhance technology transfer and economic development in the state. Eventually, industrial and government organizations that are represented in the RIAB will be asked to contribute in-kind or cash resources to support the operations of the Center. La Tech has employed such a model quite successfully for its Trenchless Technology Center for 15 years.

1.1.4 Section A: Research and Industrial Advisory Board Contributions

Dr. Les Guice (La Tech) VP for Research and Development has been a major resource and motivator to make this project a success. He has established a Research and Industrial Advisory Board (RIAB) consisting of industry leaders, and has helped develop important contacts with AF Cyber Command, national laboratories such as Sandia National Labs, and industry partners such as NetQoS, Radiance Technologies, etc.

The RIAB consists of the following members:

Brooks Keel, Vice Chancellor, Research & Economic Development, Louisiana State University; Doris Carver, Associate Vice Chancellor, Research & Economic Development, Louisiana State University; Stan Napper, Dean, College of Engineering & Science, Louisiana Tech University; Joel Trammell, Chairman of the Board, CEO, Co-Founder, NETQoS, Inc.; Chris Mangum, CenturyTel, Inc.; Craig Spohn, Executive Director/President, Cyber Innovation Center; Bob Fudickar, Director, Technology, Louisiana Office of Economic Development; Bill Bailey, Radiance Technologies, Inc.

1.1.5. New hires from support from PKSFI funding

Tenure-track assistant professor Dr. Travis Atkison will start his duties at Louisiana Tech University effective September 1, 2009.

Dr. Jean Gourd has completed one year at Louisiana Tech University as an Assistant Professor of

Computer Science.

Dr. Jian Zhang has completed one year at Louisiana State University as an Assistant Professor of Computer Science.

Other new hires have submitted research papers and have started collaboration as directed by Co-PI Iyengar (LSU). They are Vasanth Iyer, Research Associate; Dr. Gregory Vert, University of Nevada; Postdoctoral Research Fellow; and Dr. N. Parmeswaran, Visiting Professor, Australia.

Other new hires Dr. Kiran Balagani and Dr. Md Enamul Karim have began collaboration efforts under the direction of PI Phoha (La Tech).

1.1.6. Technical and Administrative Support Team

Dr. Scott Forrest (La Tech), Director of the Technology Transfer Center Shreveport, LA, Ms. Brenda S. Brooks (La Tech), Administrative Assistant.

Dr. Scott Forrest has been the Director of the Technology Transfer Center (T2C) in Shreveport, LA since October 1, 2008. He has been representing Louisiana Tech in his research activities in the development of micro and nano technologies with military, homeland defense and aerospace applications. The T2C is a modern conference center and education facility with video teleconference/distance learning capabilities. It is used by the University to facilitate technology transfer activities through meetings, conferences and workshops. The mission of the Technology Transfer Center is to facilitate the transfer of innovative ideas and technologies out of the research laboratories of Louisiana Tech and into the market place. By capitalizing on relationships and collaborations between Government, Industry, and Academia, Louisiana Tech University has aspired to develop and deliver high technology products and systems to a wide range of customers. Dr. Forrest meets regularly with Air Force, industry, and Cyber Innovation Center personnel in the Bossier area. He holds conferences and meetings on advanced technologies and their applications. He offers classes in Engineering and Technology Management and Business Administration at the facility, which includes Seminar rooms, an auditorium, a kitchen and an administrative wing. This Center serves local area schools and universities as well as government, professional and commercial organizations of all types.

Ms. Brenda S. Brooks (La Tech), Grants Administrative Assistant, was hired in November 2008, replacing Tina Allen, to provide administrative support for the Center. She is responsible for all administrative functions required in the day-to-day operations of the center. This includes account monitoring, purchasing, travel, and assisting the faculty with submitting proposals and research publications. She monitors grant status on a daily basis. She is responsible for the CSC Newsletter that is released quarterly and is a means of providing research updates and information on the activities at the Center for Secure Cyberspace at Louisiana Tech. Ms. Brooks is also responsible for maintaining the Center's website and continued composition of the quarterly newsletter. She also assisted in the organization and planning of the Second Annual Cyberspace Workshop held in connection with Cyber Innovation Center's Air Force Symposium held in June.

1.2.   Controls in Place to Ensure Project Requirements

The PIs, Co-PIs, and senior researchers have met and discussed research progress and directions of research during the whole year. The coordination mechanisms include face-to-face meetings, Access Grid meetings, and phone and conference calls.

The PI Phoha, and the LSU lead Co-PI Iyengar, and Senior Consultant Ray meet <u>every week</u> by phone to discuss progress of the project and overcome deficiencies in research. In addition, almost all the researchers have had frequent face-to face meetings.

Details of the meetings in which all (or most of the PKSFI team) were present follow:

Cyberspace Research Workshop (June 15, 2009): This workshop will be held in Shreveport, Louisiana. It will provide a venue to share eleven peer reviewed research papers with peers across the country, and will coincide with the Air Force Cyberspace symposium. The conference expects high attendance and extensive media coverage.

Research and Industrial Advisory Board Meeting (June 15, 2009): The second meeting of the RIAB is slated to be held at the Hilton Convention Center in Shreveport, Louisiana. During the first half of the meeting PI Phoha will acquaint the RIAB with the progress made thus far by the Research Team; during the second half of the meeting the work of each researcher will presented via slide presentation. The feedback from the RIAB will help improve the teams' activities.

Meeting at LSU (November 26, 2008; February 19, 2009): The most recent meeting of the PKSFI research team was held in on the campus of LSU to discuss the progress of the PKSFI research. The present were PI Phoha, Co-PIs Iyengar, Allen and Chen, Dr. Tevfik Kosar and Dr. Jian Zhang.

The above meetings are in addition to the regular meetings that PI Phoha has with individual researchers and Co-PI Iyengar has with LSU on part of the PKSFI team.

Access Grid Meetings (On December 8, 2008): One Access Grid meeting with La Tech, LSU researchers and Penn State Consultant Asok Ray were held to discuss progress report.

2. ACTIVITIES AND FINDINGS:

The team, collectively and individually, has successfully addressed various research tasks outlined in the proposal. The research has resulted in 47 scholarly publications published or accepted for publication, 2 reports of invention filed, and 20 research papers submitted and under review for publication.

Figure 2.0 summarizes the plans for benchmarking performance and progress in infrastructure, research, and statewide impacts.

Year 2		
Infrastructure	Securing additional external funding	Newly hired faculty will submit at least two research proposals to sustain and extend the current research.
	Build strategic collaborations with national and international academic and industrial partners	December 2008
Research Activity	Publications, presentations, lectures	6 publications, 6 presentations
	Research Milestones	Initiate research specific to needs of the AF. Initiate research on energy-efficient survivable routing for the dissemination and transmission of sensor data to distributed cyber systems.
Statewide Impact	Reports of Invention	3
	Increase presence of RIAB companies	March 2009
	SBIR grant applications	2
Contingency Plans	Core faculty members are active in research and expect no problems in submitting research proposals in collaboration with newly hired post-docs and research faculty. We expect no problems in meeting the objectives of the year 2.	

Figure 2.0 : Performance Measures and Expectations for Year II from (1 June 2008 – 31 May 2009)

2.1. Describe major research and educational activities undertaken in this reporting period;

Figure 2.1 identifies the focus areas of the proposed research with a description of the four major research tasks and their status. A check mark indicates the task has started and the unfilled concentric circle indicates task has not yet started.

Research Areas	Task Description	Status
Research Area #1 *Investigate network formulation providing robust placement algorithms in uncertain environments and ill defined topologies.*	• T.1.1 Network Architectural Design Using Socio-Biological Principles • T.1.2 Adaptive Sensing in Non-stationary Environments. • T.1.3 Embedding of Sensor Information at Grid Locations.	☑ ☑ ○
Research Area #2 *Develop secure transmission to distributed cyber systems and build energy-efficient survivable communications routing and protocols for sensor data dissemination;*	• T.2.1Develop Adaptive Attack Detection Mechanisms for Secure Transmission to Distributed Cyber Systems • T.2.2 Develop Resilience to Node Capture • T.2.3 Develop Robust Broadcast Routing Protocol for Sensor Networks • T.2.4 Develop Algorithms for Optimal Transmission Scheduling Under Power Constraints	☑ ○ ☑ ○
Research Area #3 *Develop automatic sensor data fusion, processing, and tools for integrated prediction, detection, and estimation for disaster precursors.*	• T.3.1 Rare Event Pattern Identification • T.3.2 Finding the Spatial-temporal Origins of Rare Events Based on Sensor Data • T.3.3 Secure Sensor Data Aggregation • T.3.4 Robust Sensor Data Fusion Using Dependence Tree Models	☑ ☑ ☑ ☑
Research Area #4 *Develop visualization software modules and perform experimental validation with simulated and actual sensors.*	• T.4.1 Develop Visualization Tools • T.4.2 Develop Smart Micro and Nano Scale Sensor Nodes • T.4.3 Validate Mathematical and Software Tools on Simulated and Actual Network of Sensors in the Center of Excellence	☑ ☑ ○

Figure 2.1: Research Activities & Status by the End of the Second Year of Funding.

2.2. Describe and provide data supporting the major findings resulting from the listed activities;

Figure 2.2A verifies the research focus with data supported by task analysis.

Figure 2.2A: Research Focus During Second Year of Funding

Figure 2.2B: Illustrates the milestones for the Year 2 as promised in the proposal and the status. A checked box means the milestone has been achieved and a checked box and a filled solid circle demonstrate performance has exceeded the milestone.

	Year 2: June 2009 Promised	Status	Comments
Research Activity			
Research Milestones	Research specific to AF needs Sensor data to dist systems	☑	Software demo to AFCYBER Gen Lord and his group Continued technology development
Publications	6 Publications/ 6 Presentations	☑ ⊙	Over 32
Funding	RoI –2 SBIR --2	☑ ◯	Cyberspace Research Lab ONR Science of Autonomy DEPSCoR 3 SBIR under development
Infrastructure			
Laboratories	---	☑	$2.86 M CSL Lab funded Cyberspace Education Funded
Funding	2 SBIR Grants	Obtained over $12M	+ 2 SBIR/STTR grants submitted (Selmic); 2 under development
Collaboration	National & Informational	☑	Visitors: ULAR & Australia; Work with ULL & Penn State
Students	---	☑ ⊙	Over 14 Ph.D. students recruited
State-Wide Impact			
Technology Transfer & Funding	---	⊙	Extensive
Link with Companies	---	⊙	2
Support with AFCYBER	Collaborate	☑ ⊙	Extensive
Conferences	---		2nd Cyberspace Research Conference

Figure 2.2B: Milestones Projected for Year II and Status at the End of Year II

2.3. Describe the opportunities for faculty recruitment, retention and development, as well as post-doc, graduate and undergraduate student training provided by your project;

We are happy to report that all the positions are filled at Louisiana Tech University with the tenure-track assistant professor accepted with a start date in September of 2009. The post-doctoral scientists are already in place at La Tech as well as currently at LSU.

2.3.1. Louisiana Tech University

After a comprehensive national selection process, La Tech has now in place the following:

Dr. Travis Atkison hired as a tenure-track assistant professor. He will start his duties effective September 1, 2009.

The following faculty members and post-doctoral scientists have been hired and supported in part from the grant:

1. Dr. Jean Gourd (Assistant Professor).
2. Dr. Kiran Balagani (Research Assistant Professor).
3. Dr. Md Enamul Karim (Research Assistant Professor).

Dr. Jean Gourd has completed his first year of commitment with the university. Dr. Kiran Balagani and Dr. Enamul Karim are currently working under the direction of Dr. Vir Phoha and are collaborating with other professors and departments at the Louisiana Tech University and Louisiana State University.

Both La Tech and LSU have supported graduate and undergraduate students. La Tech has supported the following students:

Graduate Students: Sudhir Shrestha, Mohammad Baig, Shrijit Joshi, Abena Primo, Jun Dong Chen, Guyu Zhang.

Undergraduate Students: Thomas Goodwin, Chuka Okoye

2.3.2. Louisiana State University

After a comprehensive national selection process, the following faculty members and post-doctoral scientists have been hired and supported in part from the grant:

4. Vasanth Iyer (Research Associate).
5. Dr. Gregory Vert (University of Nevada, Postdoctoral Research Fellow).
6. Dr. N. Parmeswaran (Visiting Professor, Australia).

LSU has supported the following students:

Graduate Students: Srini Srivasta, Ismail Akturk, Huy Phamg,

2.4. Describe the nature and scope of partnership activities; and

"Cybersecurity Laboratory Proposal" has been funded from the AFOSR Program with an award amount of $2.8 M.

"Detecting and Patching Coverage Holes (DEPCH) in Wireless Sensor Network Proposal" has been funded from NSF/BOR/Pfund in the amount of $10,000.

"Cyber Education Proposal" has been funded from the Department of Education Program to sponsor a Cyber Academy with funding in the amount of $1 M.

- More information about this can be found in the section below under the heading EDUCATION.

2.5. Describe any problems encountered during the last year of project activities;

None.

3.   CONTRIBUTIONS: SUMMARIZE EFFORTS MADE TO BUILD RESEARCH AND EDUCATION CAPACITY, SECURE EXTERNAL FEDERAL   AND PRIVATE-SECTOR FUNDING, BUILD   INFRASTRUCTURE, CONTRIBUTE TO ECONOMIC DEVELOPMENT, AND ENSURE PROJECT SUSTAINABILITY OVER THE LONG TERM.

The core research team is now composed of fifteen Ph.D. faculty members. One more is expected to join the core members of the team in September. The team consists of Assistant and Associate Professors, Two Research Associates, One Post Doctoral Associate and One Senior Consultant who is deeply involved in the Center activities. Each of these members will submit research proposals to build research and education capacity and secure external funding. Both **La Tech and LSU have made it a priority to hire the best talent.**

The team has already submitted 8 new proposals for funding, 2 of these proposals have been successful; 1 is in the final stages of negotiations, and 5 are pending. Details follow.

Funded Proposals

(1) "Advanced Development and Integration of Keyboard Biometric Techniques to Support Information Operations", PI Vir Phoha; 08/21/2008; AIS/ $221,260 has been funded.

(2) "Distributed Autonomy for Intelligent Decision Making, Adaptive Learning and Robust Collaboration," PI Vir Phoha; 06/01/2009; ONR/ $340,000 has been funded

(3) "Cybersecurity Laboratory," PI Les Guice, Co-PI Vir Phoha, Co-PI Md Enamul Karim; 03/20/2009; AFOSR/$2,848,860 has been funded.

Proposals Under Consideration

Title: Building Research and Education Cyberinfrastructure for Enhancing Disaster Management on Northern Gulf Coast
Agency: NSF/EPSCoR
Duration:
Total Budget: $225,000
Investigators: Peter Chen, S.S. Iyengar, Vir Phoha
Status: Pending

Title: <u>Obfuscation and Deobfuscating of Intent in Computer Programs</u>
Agency: BOR/DEPSCoR
Duration:
Total Budget: $232,544
Investigators: Vir Phoha
Status: Pending

Title: <u>Real-time Determination and Prediction of Aircraft Trajectories Using Limited Sensor Data</u>
Agency: NAVY
Duration: 10 Months
Total Budget: $32,000
Investigators: Rastko Selmic
Status: Pending

Title: <u>Swarm/agent Technology For Small Unit Scalable Effects</u>
Agency: ARMY
Duration: 10 Months
Total Budget: ~$27,000
Investigator: Rastko Selmic
Status: Pending

Title: <u>Sensor Network Coverage Control Using Simpicial Homology</u>
Agency: NSF
Duration:
Total Budget: ~$346,038
Investigator: Rastko Selmic, PI and Jinko Kanno, Co-PI
Status: Pending

Title: Cyber K-12: Building a Foundation for Cyber Education in North Louisiana
Agency: Department of Education
Duration:
Total Budget: ~$950K
Investigator: Galen Turner, PI and Christian Duncan, Co- PI
Status: Pending

3. PROJECT REVISION: PROVIDE A LISTING OF AND EXPLANATION FOR ANY SIGNIFICANT CHANGES IN THE WORK PLAN FOR UPCOMING YEAR, INCLUDING ANY CHANGES IN THE AMOUNT OF INVESTIGATORS' TIME DEVOTED TO THE PROJECT. IF YOU MADE SIGNIFICANT CHANGES TO THE PROJECT DESIGN AS OUTLINE IN THE PROPOSAL DURING THE PAST YEAR, PLEASE LIST AND EXPLAIN THE CHANGES, THE PURPOSES FOR THE CHANGES, AND THE RESULTS.

The project team has changed the name of the Center to *The Center for Secure Cyberspace* replacing the name Center for Smart Cybercentric Sensor Surveillance Systems as proposed in the proposal. The reason for this name change is to make it easier to communicate to the external public and potential industry partners. No change in structure of the Center as included in the PKSFI proposal is contemplated.

SUSTAINABILITY

Louisiana Tech has also received money from the State of Louisiana to establish a multi-tenant building in its new research park (called the Louisiana Tech Enterprise Campus). The University has committed to provide 8,000 square feet of space in that building to house the Cyber Center. This will not only provide more effective space for the researchers, but it will provide ample room to develop a specialized Cyberspace Research Laboratory that will advance the research activities and foster collaborations with some of the industry partners who are expected to occupy the building with the Center faculty. This center will be dedicated to the advancement of research and education in Cyber security, sensors and networks. The Air Force Office of Scientific Research has recommended funding of the Cyberspace Research Laboratory. This grant will provide funding to provide support for new research and education efforts in cyber security with monetary provisions for equipment, technical support, research staff, faculty and students, operating costs, supplies, and travel. The proposed funding will enable the CSC and their partners to operationalize the new equipment being purchased in support of the research projects.

EDUCATION

The Center is helping to co-sponsor a Cyber Discovery Camp. The Cyber Discovery Camp was developed by a collaboration of math, science, engineering, and liberal arts faculty. The primary goal of the camp was to help teachers and students become better cyber-citizens who help rather than hinder security efforts by making them aware of the benefits and dangers of cyberspace. The residential camp exposes student participants to multiple topics of cyberspace including: history of cyberspace, ethical and social issues, applications, and the need for and use of security in cyberspace. Faculty members from the College of Engineering and Science teamed up with the College of Liberal Arts to develop a residential camp experience aimed at high school teachers and students. During the summer of 2008, 30 high school students and 10 teachers from 6 secondary schools in Northeast Louisiana participated in the summer camp. Approximately 10 La Tech Faculty ranging in disciplines in the Sciences from Computer Science, Mathematics, and Engineering to the Arts such as History, Political Science, Architecture, and English were involved. The camp consisted of discussion sessions, hands on engineering and computer science labs, a cryptographic treasure hunt, film sessions, and a final cyber challenge each of which integrated the history, ethical issues, applications, and theory behind cyberspace, security, and cryptography. The focus of the camp was the relationship between science and technology and the liberal arts programs and how they all pertain to cyberspace. Activities included studies in robotics, cryptology, history, politics, architectural design, and film.

During the summer of 2009, the camp has been expanded to include almost 50 high school students and 16 teachers. La Tech Faculty again teamed up to assist the 8 secondary schools from Northeast Louisiana. The purpose of the Cyber Discovery Camp remains to support K-12 outreach and to enhance interactions through workshops. The goals are to demonstrate the integration of fundamental topics in math, science and the humanities in the context of cyberspace. The camp utilizes multiple media formats and numerous interdisciplinary experiences to educate and raise awareness of the various areas – science, technology, engineering, and mathematics (STEM)- necessary to push research and development into the future area of Cyber Studies.

Expanded on the concepts of the Cyber Discovery Camp, and interdisciplinary college honors-level course was developed. The course enrollment for ENGR389/LBAR389, Studies in Cyberspace (Honors Course) was 16 college honors students. This course was directed by approximately 10 La Tech Faculty presenting material with cyberspace-centric topics ranging from robotics, cryptology, history, politics, architectural design, film, and literature. Participating students had majors ranging from the Sciences such as Engineering, Computer Science and Biology to the Arts in Political Science and English.