Dedicated Active Learning and Research Environment (DARE): Enhancing security awareness and training across the Commonwealth of Virginia.

January 2014 - June 2014
Final Report

Section A: Executive Summary

Our Audemeus grant provided funding to extend the capabilities of our virtual lab to an entirely new level by connecting the network to the Internet while fully isolating the campus network. This enabled greater access to a controlled environment for conducting potentially dangerous experiments while protecting the campus network. The previous network limited research and experiments to simulated data and off-line data. The new network enables users to confront live, malicious data and attacks, dramatically enhancing learning experiences.

Students in our senior-level network security course ran real-world experiments such as monitoring the world for malicious data and exploits and configuring and securing networks against live attacks – experiences that very few colleges provide but which the corporate world greatly covets in prospective employees. Further, the network expanded our ability to reach high schools thereby improving our ability to identify and recruit top students.

Our core mission is to (a) build a strong information security program that gives graduates a significant competitive advantage in the corporate world and (b) create a recruiting pipeline of high school students well prepared in information technology for RU's Department of Information Technology.

Since 2008, we have advanced our mission by:

(a) Developing an undergraduate information security program certified by the NSA and noted for its depth and strength by the NSA's reviewers.
(b) Challenging the students in the program to compete against the best information security experts across the nation through National collegiate cyber defense contests, thus preparing them for real-world situations.
(c) Developing virtual labs for computer security research and learning. Virtual labs enable us to:
   a. Create large computer networks spanning 10s of nodes without huge investment in hardware/software. Such networks provide students with an almost real-world learning experience. Further, the use of networks isolated from the main campus network is a key requirement for security research and experiments involving malicious data that must be prevented from reaching and infecting the campus network.

    b. Provide high school students access to large computer networks greatly alleviating the need for high schools to invest in expensive physical infrastructure. The ability to deliver materials through virtual networks, positions RU as the leader in raising awareness and providing education in cyber security to high schools throughout Virginia. With funding from NSA supported grants we ~~are~~ continue to develop hands-on learning materials in Information Security that high school teachers can easily incorporate into their curriculum.

Section B: Summary of the List of Outcomes and Project Status

The proposal had two main objectives:

(a) **Develop a sandbox network learning and research environment isolated from the University's network**

    Status: The main internet service provider for the University, Citizen's Internet, provided a separate internet connection link to Davis Hall. The address of this network, 192.143.254.* was completely separated from the University's main network which has an address of 137.45.*. The work to setup this network connection was completed on March 16, 2014. Two servers running virtualization software were connected to this network. The two servers supported 65 workstations simultaneously.

(b) **Demonstrate the effectiveness of DARE**

    Status:
        1. **State-wide: High school and community college cyber defense contest**
            a. Radford University's first Capture the Flag cyber defense contest was hosted on this network on March 21-22, 2014. 37 students from 3 Governor's and high schools (Shenandoah Valley Governor's School, Central Piedmont Governor's School, Stone Bridge High School) and 1 community college (Blue Ridge Community College) participated in this contest. With DARE students could compete virtually allowing schools (e.g., Stone Bridge High School from Ashburn VA) that might otherwise not participate if travel to RU was involved.
            b. A cyber-security expert from the Federal Reserve, Mr. Brad Bowers helped develop the contest software tool with the Co-PIs. With the help of Mr. Bowers we were able to organize a professional contest that included challenges that mimicked the real world.
        2. **Enhanced learning experiences**
            a. Students in a senior level security course taught in Spring 2014 (ITEC 445), used the network to execute real-world security projects including:
                i. Setting up a Honey-Pot to track live and real world attack data.
                ii. Testing the effectiveness of perimeter security mechanisms. With the help of DARE, students had to secure their networks against live attacks that are very hard to simulate in a class room setting.

Section C: Significance of the Project

Central to the success of our mission is providing a research and learning environment that can support live projects in computer security and other areas of IT. An effective research and learning environment will support large dynamic computing networks that are isolated from operational resources. Such a research and learning environment will:

(a) Dare RU's students to conduct real-world experiments and give graduates a competitive edge by exposing them to enterprise-level tools and computer networks -- an experience that very few colleges provide.

(b) Increase the reach and scope of our outreach efforts to high schools thus increasing the pipeline of high school students into the Department of Information Technology. Currently there are three significant web-based resources that instructors can use to introduce cybersecurity curriculum into high schools: US CyberPatriot (www.cyberpatriot.org), SANS cyberaces (www.cyberaces.org) and Hacker High School (www.hackerhighschool.org). All these efforts provide very little real-world experience, especially in the area of network security.

(c) Increase Radford University's prestige by being one of the few schools stressing real-world live experiments. Such a lab would also enhance our collaboration with corporate world specifically through the newly created Artis Lab.

To provide real-world experiences we have usually relied on creating networks of computers that are isolated from the main campus network to prevent any experiment from effecting the campus network. This implied that the isolated set of computers had limited internet connectivity.
 The Audemeus grant project, by providing us with the support to install and test a real-world network that is not isolated from the Internet (but is isolated from the campus network), helped us test the feasibility and utility of such a network.

Section D: Personnel

Dr. Prem Uppuluri, Dr. Jeff Pittges, Dr. Joe Chase, Dr. Art Carter (Department of Information Technology)

Section E Future Plans

With the Audemeus grant and the two NSA grants that we received (one in 2013-14 and one current: 2014-15), we have collected preliminary results that will enable us to develop competitive proposals for external grants including the NSF sponsored Innovative Technology Experiences for Students and Teachers (ITEST) grant in November 2014. The Additional funding will enable us to create a new paradigm for research and learning in computer security.

Section F Broader Impact

In this present day the famous quotation by Benjamin Franklin can probably be modified to read as "In this world nothing can be said to be certain, except death, taxes and our dependence on computers". Given that the large number of vulnerabilities that are exploited on computational infrastructure stem from human errors, there is a dire need to ensure that each and every child is taught to become an effective cyber-citizen. This entails understanding the need and basic ability to follow secure and ethical policies on the Internet. The DARE lab can provide an in-depth learning experience to high school students who usually cannot experiment with large scale computational networks. It has the potential to become a model to the nation to train our future cyber-citizens.

Computer security also gets a large amount of coverage in the popular media as an exciting field of study. In fact we believe that most teenagers can relate with exploits to computational infrastructures such as social networking sites and smartphones. By teaching computer science concepts using computer security as a vehicle, we may be able to spark a passion for computer science and other STEM areas. The hands on experiments that the DARE lab can host will support and sustain this passion.