BUILDING A CYBERSECURITY PIPELINE THROUGH EXPERIENTIAL VIRTUAL LABS AND WORKFORCE ALLIANCES

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Agenda

- Introduction
- Project overview
- Virtual laboratories
- Internships
- Capstone projects
- Workshops
- Conclusion and Future work

Introduction

- The primary institution of this project is the University of South Carolina (USC)
- Other institutions are Northern New Mexico College (NNMC) and University of South Florida (USF)
- The project is motivated by the need of cybersecurity professionals
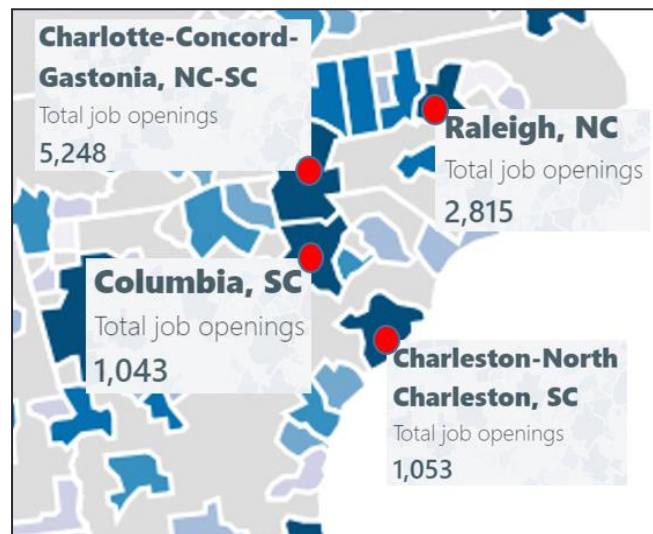
Project Overview

- The project goals are:
  - ➢ Strengthen the cybersecurity curriculum in three degree programs (USC, NNMC, USF) using virtual laboratories (vLabs)
  - ➢ Establish cybersecurity-related internships and capstone projects in conjunction with national laboratories and industry
  - ➢ Increase the capacity for education of cybersecurity professionals in SC, NM, and FL

- Key partners include agencies, private businesses, and national laboratories
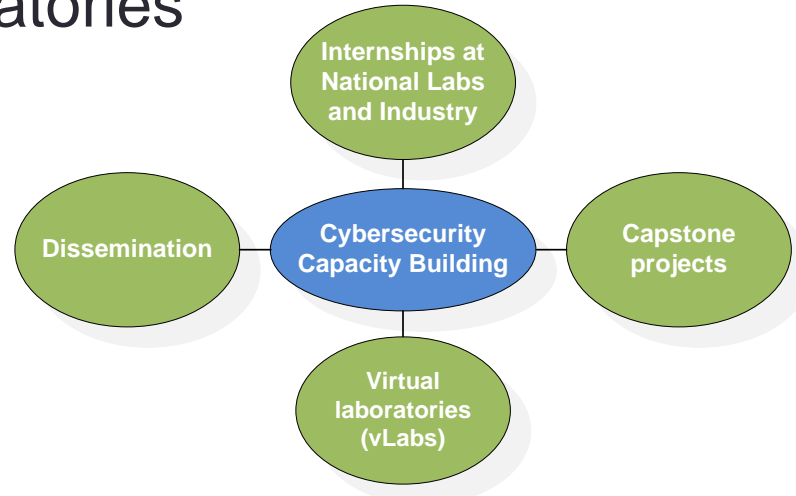
Virtual Laboratories

- Hands-on experiences are essential in IT
- Physical labs are not scalable, they require maintenance
- Time consuming to setup the experimental environment
- Costly in labor (technician), equipment, and space

How to include authentic practice, professional tools and platforms, access to computing technology in the work environment in a **scalable way**?

Virtual Laboratories

- Virtual platform based on virtual machines (VMs)
- Pods launched on demand on an server hosted in IIT
- Access to the virtual platform via web interface
- Development of custom pods
- Pod elements (computer, firewall, router, equipment) are VMs rather than physical devices
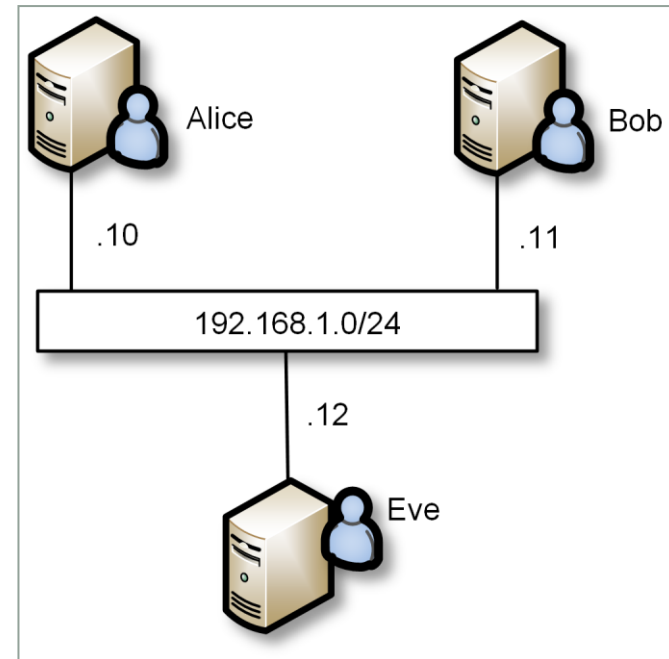
Partnership w/ NDG[1]
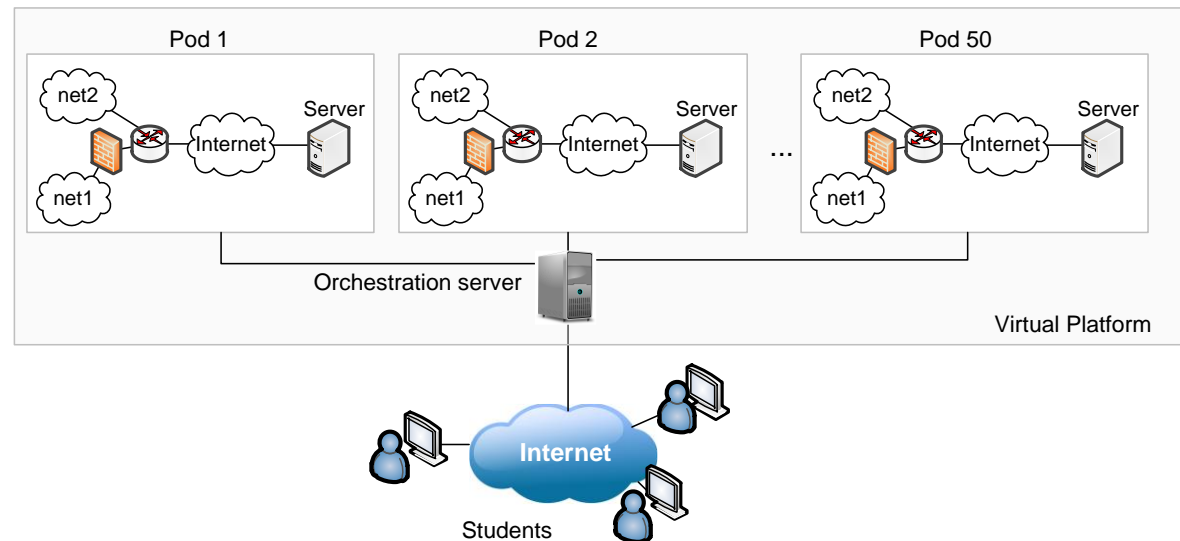
1The Network Development Group (NDG), www.netdevgroup.com

Pod Examples – Introduction to Cryptography

- Symmetric-key encryption
- Generation of public keys
- Public-key encryption
- Certificate authorities
- Digital signatures
- Digital envelopes
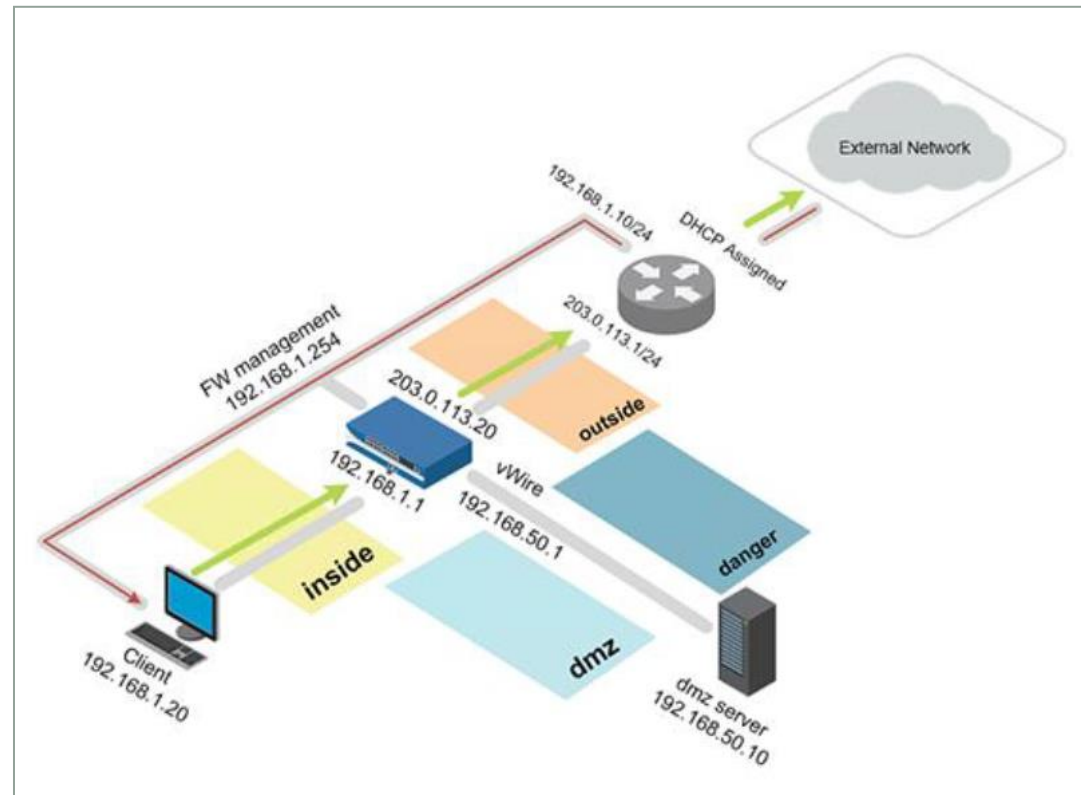- Web of trusts
- Encryption protocols

Course: ITEC 493 (Security)

Pod Examples – Next-generation Firewalls

- Firewalls
- Malware analysis
- Application identification
- User identification
- URL filtering
- Virtual Private Networks
- Monitoring and reporting
- Modern techniques for malware identification
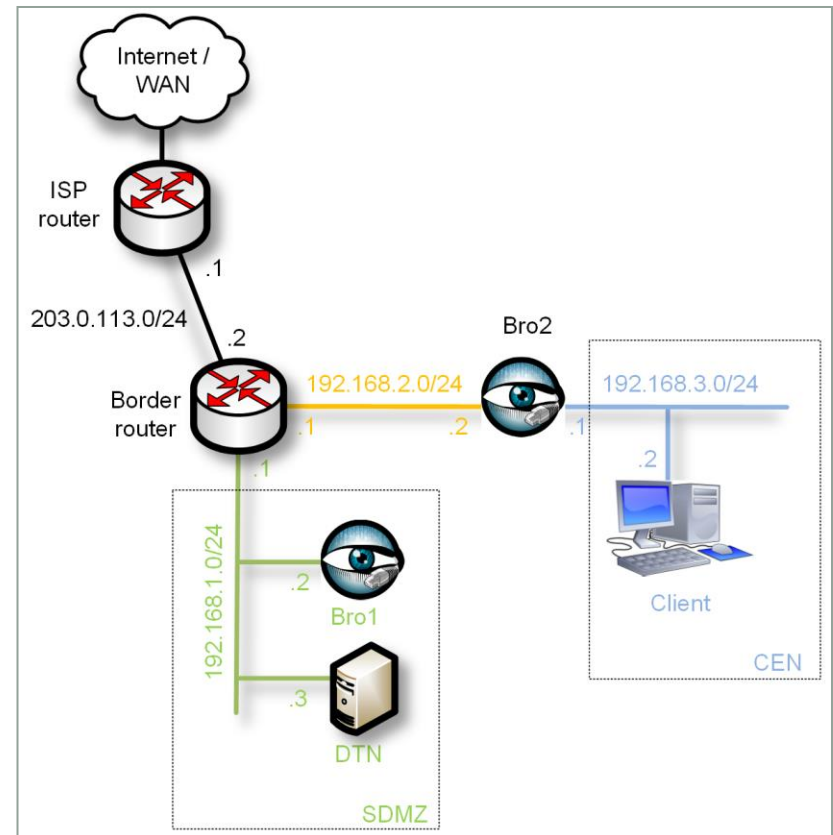- Palo Alto Firewalls provided VMs at no cost

Course: ITEC 493 (Security)

Pod Examples – Bro Intrusion Detection

- High-performance tools
- Big data transfers
- Access-control lists
- Traffic routing for high speeds
- Intrusion detection systems
- Passive network monitoring

Course: ITEC 493 (Security)

Virtual Laboratories - Impact

- Virtual labs currently used in two courses at USC and NNMC, and one course at USF

- Spring 2019: ~50 students

- Hours attended: 1,399.25

- Hours per user: 27.9

- Hours per user / week: 2.5

Admin > Usage > Community Usage > List

📈 Community Usage   Search

| ID	Name	Reservations Made	Labs Attended	Hours Reserved	Hours Attended
1	default	835	794	2457.50	1399.25
	Page Total:	835	794	2457.50	1399.25
	Table Total:	835	794	2457.50	1399.25

Showing **1 to 1** of **1 items**

Internships

- Students are required 400 hours of internship for graduation
- Prior to the internship, students take a 3-credit seminar
- The seminar matches students' interest and skills with business needs
- Internships permit students to develop real-world cyber-skills, and ease their transition from academia to the workplace
- Students gain employability and soft skills

Internships

- Recruitment of companies

- Internship seminars

- Workshops on how to apply to internships: twice per year
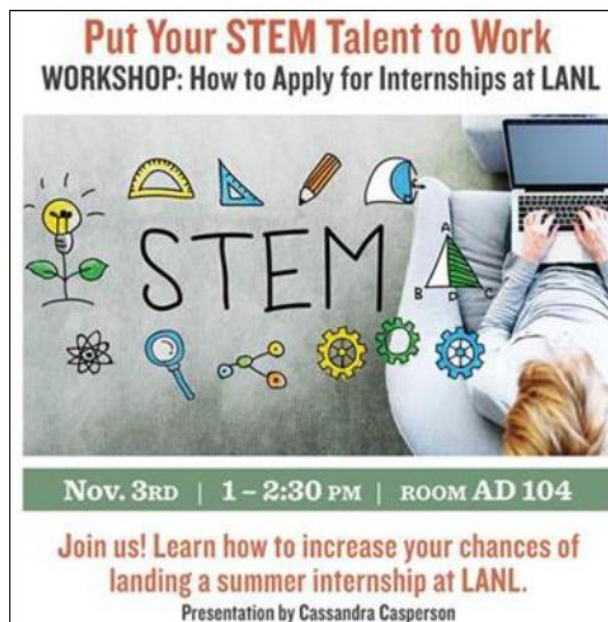
Internships - Impact

- Companies recruited during the first year of the project

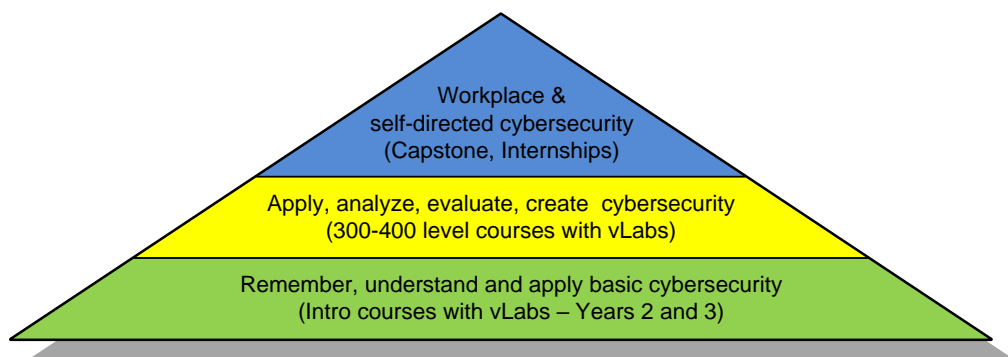| Company	Location	# positions
Los Alamos National Laboratory	Los Alamos, NM	8
Capgemini	Columbia, SC	1
IT Services USC	Columbia, SC	2
SC Department of Education	Columbia, SC	1
USC	Columbia, SC	1
Global Pundits	Lexington, SC	1
Savannah River National Lab	Savannah River Site, SC	3
SC Government	Columbia, SC	1
IBM	Columbia, SC	1
SC Cyber	Columbia, SC	3
U.S. Air Force	Charleston, SC	1
Blue Cross Blue Shield	Columbia, SC	2
SC Election Commission	Columbia, SC	1
Sealed Air	Simpsonville, SC	1
Spirit Communications	Columbia, SC	1
Charles Schwab	Phoenix, AZ	1
TOTAL		29

SRNL Interns Meet and Greet

Internships Presentation Day

Capstone Projects

- A pilot component of this project is the integrative capstone

- Students work in teams to complete an industry-sponsored capstone project

- ~10 cybersecurity capstone projects per year

Workplace &
self-directed cybersecurity
(Capstone, Internships)

Apply, analyze, evaluate, create cybersecurity
(300-400 level courses with vLabs)

Remember, understand and apply basic cybersecurity
(Intro courses with vLabs – Years 2 and 3)

USC Discovery Day
(Capstone presentations)

Dissemination – Workshops

- Activities rely on a good cybersecurity preparation
- Virtual Labs are fundamental (hands-on skills)
- The project team organizes workshops on "Developing Virtual Labs"

Dissemination – Workshops

- During the first year of the project, two two-day workshops were organized

  ➢ 1st workshop: 30 instructors

  ➢ 2nd workshop: 61 instructors / 25 states
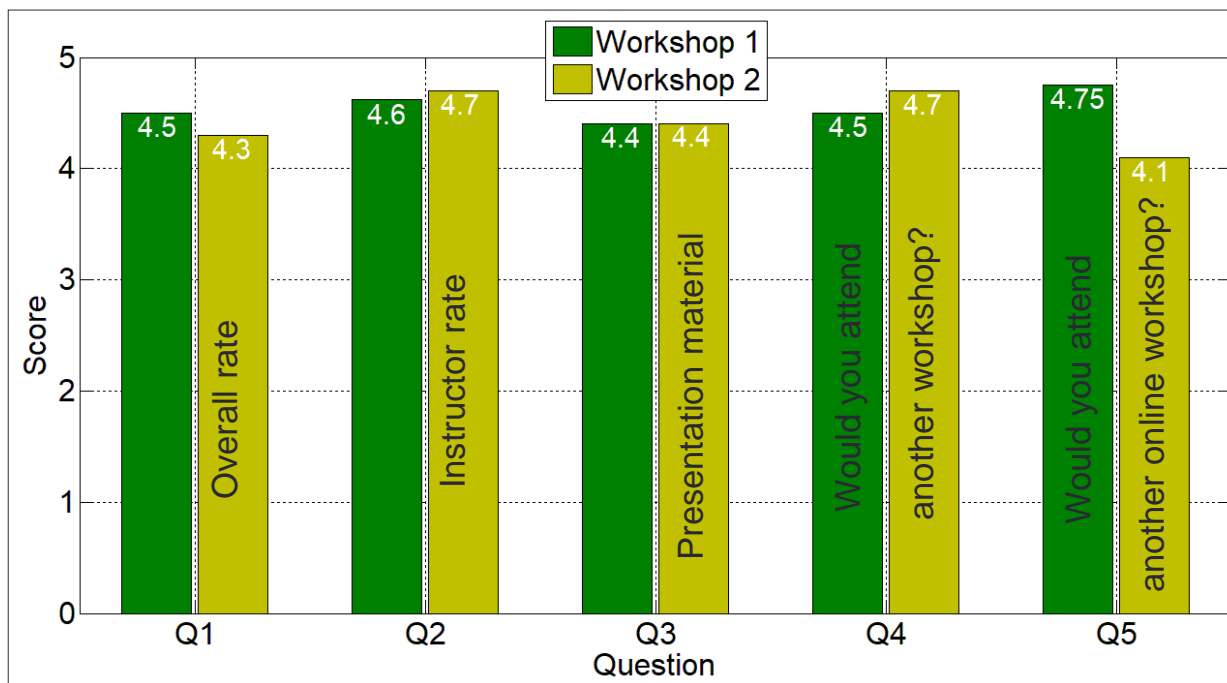
➢ 5: Extremely satisfied
➢ 4: Very satisfied
➢ 3: Moderately satisfied
➢ 2: Slightly satisfied
➢ 1: Poor / not at all satisfied

Conclusion and Future Work

- This project enhances the cybersecurity education in multiple institutions in SC, NM, and FL

- Components
  - ➢ **vLabs:** permit students to learn core cybersecurity concepts combined with authentic practice and use of professional tools
  - ➢ **Internships and capstones:** permit students develop real-world cyber-skills; gain employability and soft skills; and transition from academia to the workplace
  - ➢ **Dissemination:** strong interest in the adoption of vLabs is reflected on the attendance to the workshops (100 instructors, from more than 70 institutions in 25 states)

- Future work includes
  - ➢ Quantify the impact of the different activities
  - ➢ Expand capacity for vLabs and internships
  - ➢ Continue to recruit companies for internships and capstone projects