

CMU Support to Cyber Capacity Building

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Operational Readiness & Evaluations
CERT Cyber Workforce Development

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Agenda

- Introduction & Background
- Support to Cyber Capacity Building
 - Cyber Endeavor
 - Crucible Simulation Framework
 - Gauntlet in the Cloud



CMU Software Engineering Institute (SEI)

- Founded in 1984 by DoD as the only R&D software engineering FFRDC
- Focus on software engineering, cybersecurity and artificial intelligence research
- ~730 total employees
- Headquarters in Pittsburgh, PA; Other offices near strategic partners in CA, MA, MD and VA

CMU Campus – Global Research University

- Global research university known for its world-class, interdisciplinary programs in computer science, machine learning/artificial intelligence, engineering, business, arts, policy, and science
- Ranked #1 for Computer Science; #1 for AI; #4 for College of Engineering
- 1,442 total Faculty and 130 Research Centers



XNET: team-based exercises

Cyber Flag: largest DoD joint cyber exercise

Gaining Cyber Dominance: most realistic cyber experience for Army Regional Cyber Centers

STEP: Simulation, Training and Exercise Platform

Marine Corps Cyber Operations Readiness Curriculum

TopoMojo: lab builder

Foundry: learning experience platform

Crucible: simulation framework

CyberForce

President's Cup

...building and facilitating DoD cyber exercises.

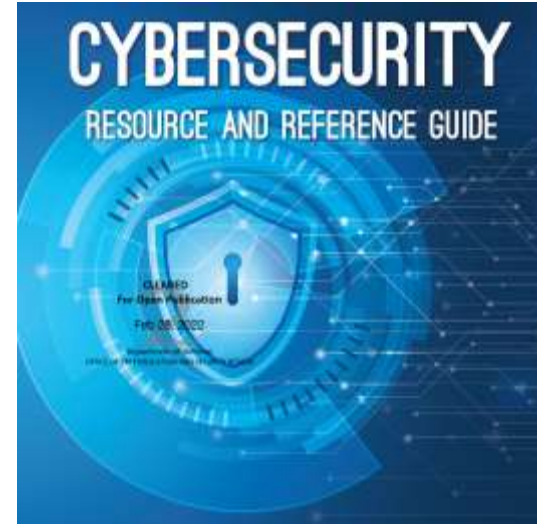
Key

- Software Platform Development
- Customer-specific Events & Projects

Cyber Capacity Building

- Developing a Cybersecurity Strategy and Supporting Policies
- Building Defensible Networks and Protecting Networks from Incidents
- Critical Infrastructure Protection
- Managing Access in Systems and Data
- Building and Maintaining a Cyber Workforce
- **Build Cyber Capacity**
- **Information Sharing**
- **Interoperability**

***Influenced by standards, frameworks, and academia**



Cyber Endeavor



- Cyber Endeavor is a multi-national event where U.S. partner nations and INDOPACOM get together to build cybersecurity capacity and promote information sharing.
- Participants are invited from multiple countries to transfer knowledge, build cyber skills, and enhance cooperation through a facilitated event.
- Event leveraged a regionally deployed cloud based solution to ensure a high fidelity and reliable user experience.
- CMU used open-source software and open code technology as a basis for the platform.
- Solution leveraged CMU's Crucible Simulation Framework

Cyber Endeavor Knowledge Transfer Methodology

- Instructor/Mentor Approach
 - Facilitator led—CMU provide initial hybrid instruction through Zoom or MS Teams aligned to learning objectives
 - Hands-on, high fidelity virtual environment. Approach includes learning objectives, which provides a checks and balance for progress during hands-on/lab work ([incorporating NIST frameworks into Moodle learning competencies ISO Cyber Endeavor 2022](#))
 - Protect the Flag HADR event
 - [Future integration of President's Cup Content](#)



An open-source cyber training platform.

Maximize **content reuse** & repeatability

- Infrastructure as code

Maximize **modularity**

- API-first

Maximize **extensibility** -- easily integrate third-party applications

- Leverage open source and existing technologies where possible

Maximize **customization** and flexibility for content developers

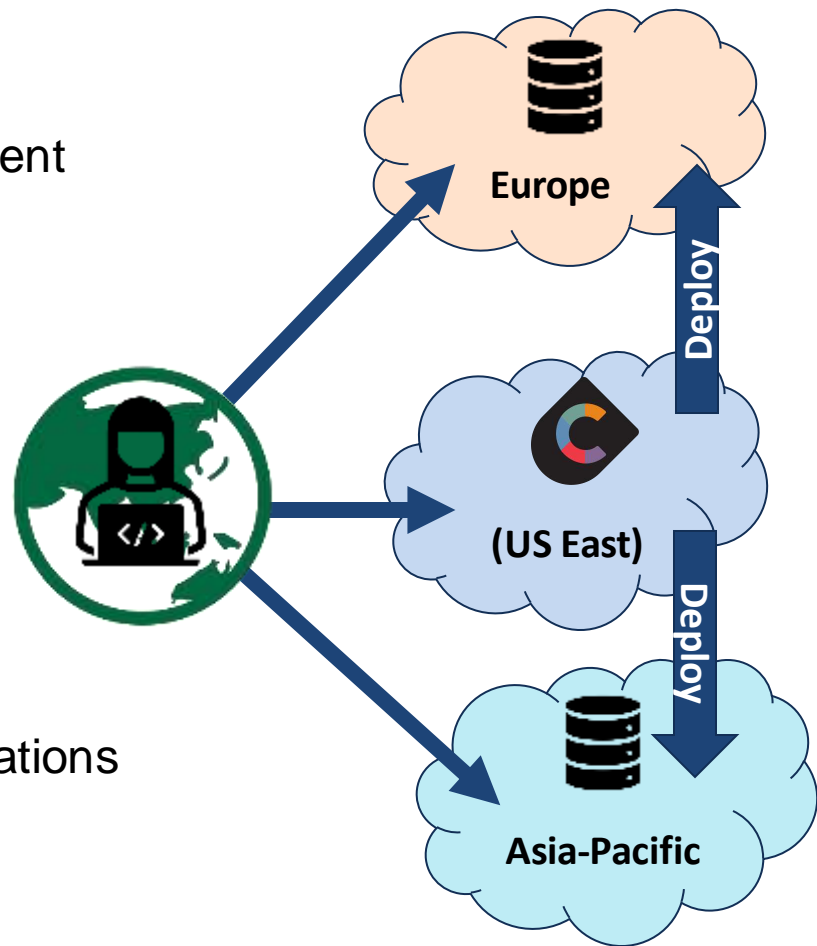
Maximize the use of **open-standards**

Dynamic HTML5 interface with Angular components

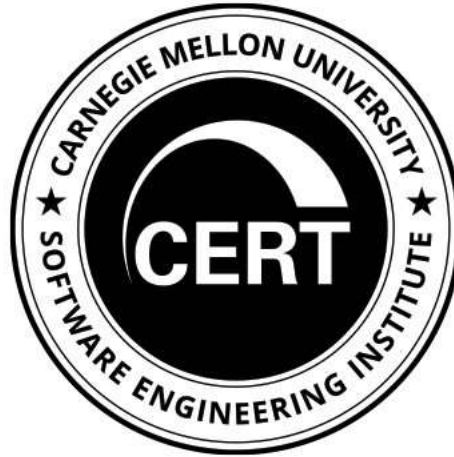


Way Ahead

- On-demand, **global access** to learning content
- **Platform-agnostic**
 - Supports variety of cloud providers
 - Deploy to local datacenters
- Reduced **costs**
- **Integration** and collaboration with partner nations



Questions



Crucible Core Components



Player



Caster



Steamfitter



Alloy



SEER

Player: The User-Experience App



- Primary user-facing application where teams engage in training labs or exercises
- Supports multiple teams/users per event
- Customizable interface provides access to virtual machines, documentation, and links to other apps

Caster: Topology Design & Deployment



- Topology design and deployment tool
- Utilizes open-source applications to provide infrastructure-as-code functionality
 - Terraform
 - Gitlab

Steamfitter: Scenario-Event Design & Execution



- Orchestration tool that allows exercise administrators to design a series of tasks to execute on virtual machines
- Event facilitators can monitor and control task execution or allow users to manually execute tasks
- Utilizes the open-source Stackstorm event automation engine

Alloy: The On-Demand Event Creator & Launcher



- Combines for an on-demand crucible event:
 - Player's interface
 - Caster's topology definition
 - Steamfitter's task schedule
- Users who launch an event can invite others to participate
- Events can be scored and results retained for future analysis and comparison

SEER: Team Performance Assessment



- Enables assessment and comparison of team performance of mission-essential tasks
- Maps training objectives to scenario events/injects to performance assessments
- Utilizes TheHIVE, an open-source security incident response platform

Crucible Open-Source Extensions

- CMU Developed:
 - IdentityServer 'OpenID Connect' authentication and identity management
 - GHOSTS NPC orchestration
 - WELLE-D Wireless network emulation
 - Topgen Internet service simulator
 - Greybox Internet simulator on a single VM
- Third Party:
 - Moodle Learning management system
 - osTicket Service-Desk system
 - Mattermost ChatOps

Crucible: a cyber simulation framework

For more information:

<https://sei.cmu.edu/go/crucible>

<https://cmu-sei.github.io/crucible>

<https://github.com/cmu-sei/crucible>

or email us at:

info@sei.cmu.edu

Crucible Roadmap

- VLAN management
- User-activity statistics
- Caster “easy-mode”
- Azure-cloud hypervisor support expansion
- Terraform module expansion
- Cyber-challenge competitions
- oVirt/KVM hypervisor support
- Possible migrations:
 - Identity -> Keycloak
 - Mattermost -> RocketChat