CMU Support to Cyber Capacity Building

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Operational Readiness & Evaluations
CERT Cyber Workforce Development

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Agenda

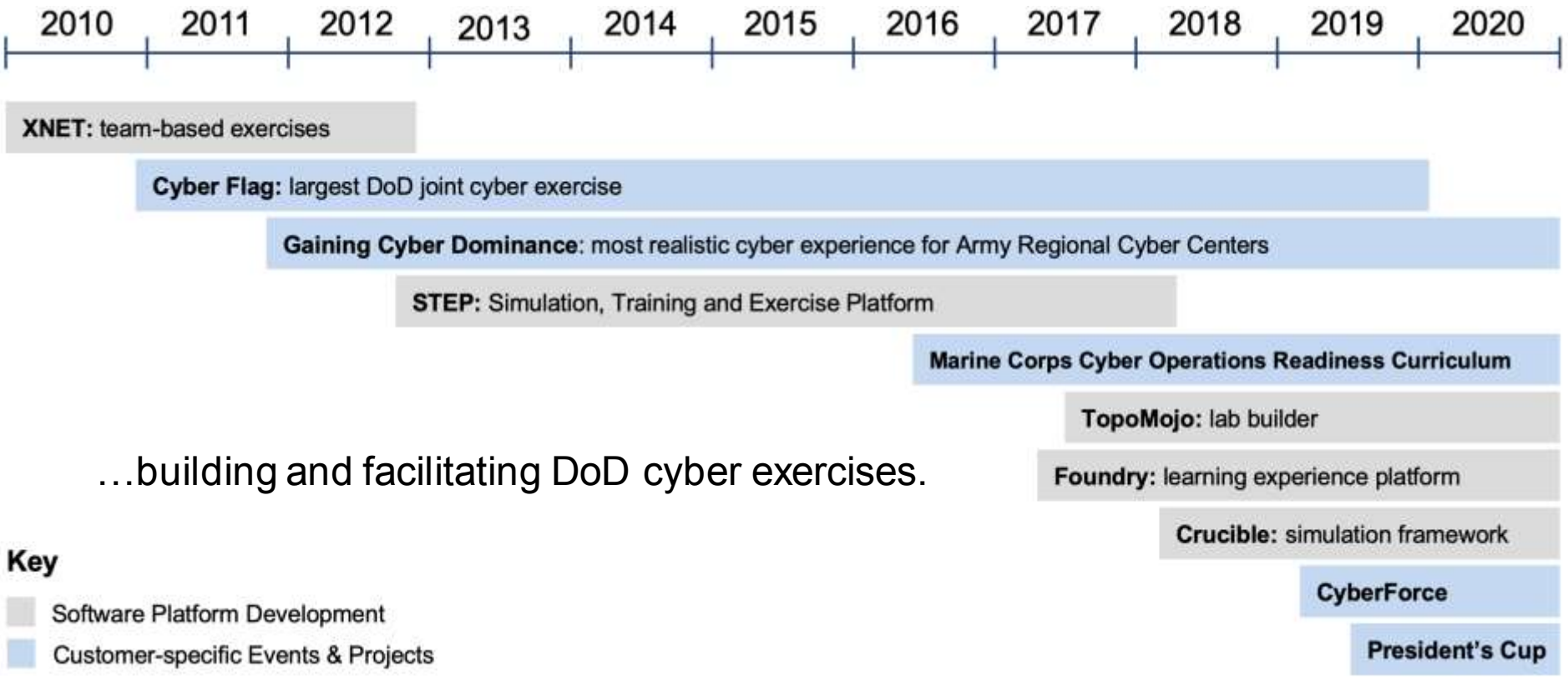
- Introduction & Background
- Support to Cyber Capacity Building
  - Cyber Endeavor
  - Crucible Simulation Framework
  - Gauntlet in the Cloud

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

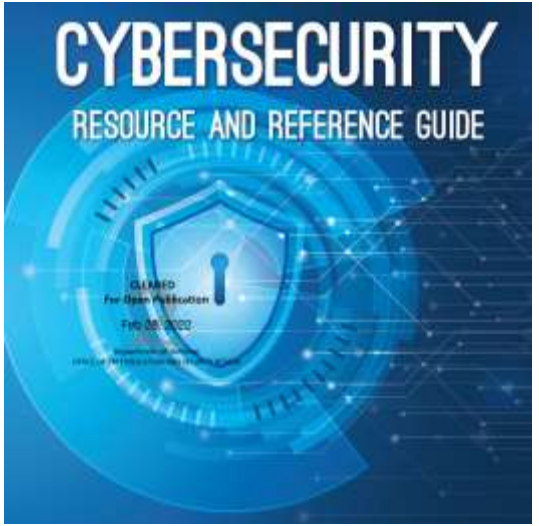
CMU Campus – Global Research University

- 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



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

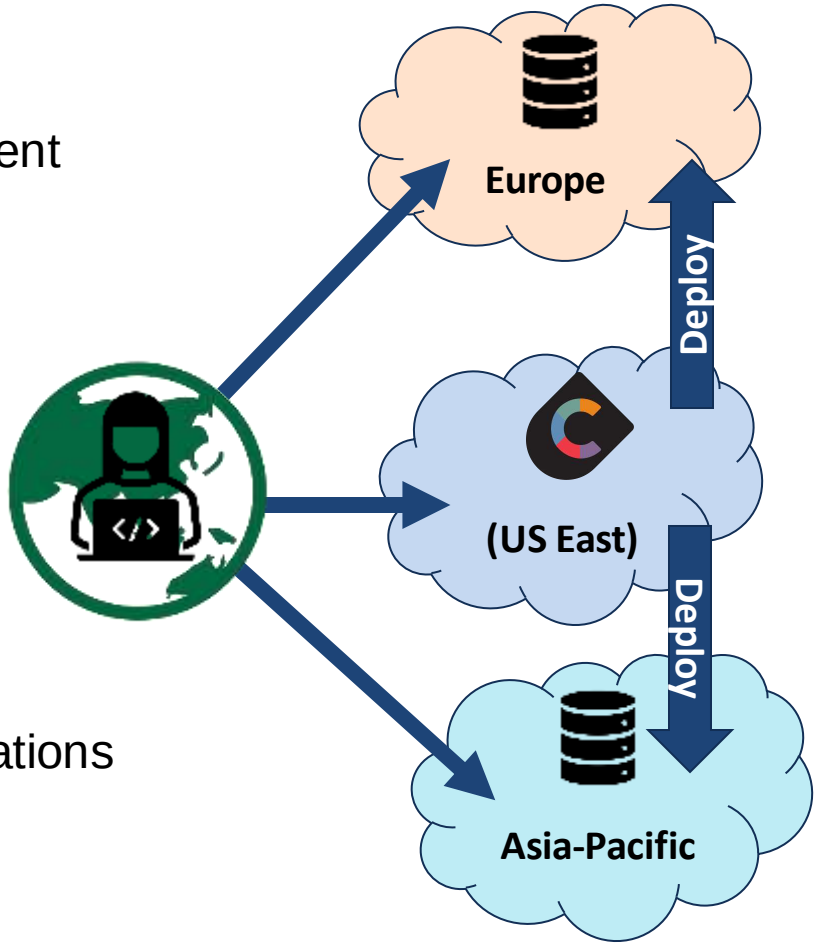
Maximize **customization** and flexibility for content developers

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



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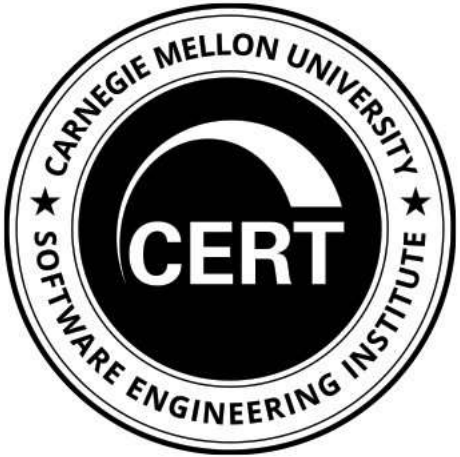
Questions



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

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