# Sharpening Skills with Immersive Threat Hunting Experience-Building

**Modeling, Simulation, & Exercise Initiative**
CMU / SEI / CERT / CWD
17 November 2022

Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA 15213

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DM22-1106

# How We Could Fit In

# Who We Are

- Cybersecurity Engineers
  - Infrastructure
  - Cyber Operations
  - Software / DevOps
  - Data Science

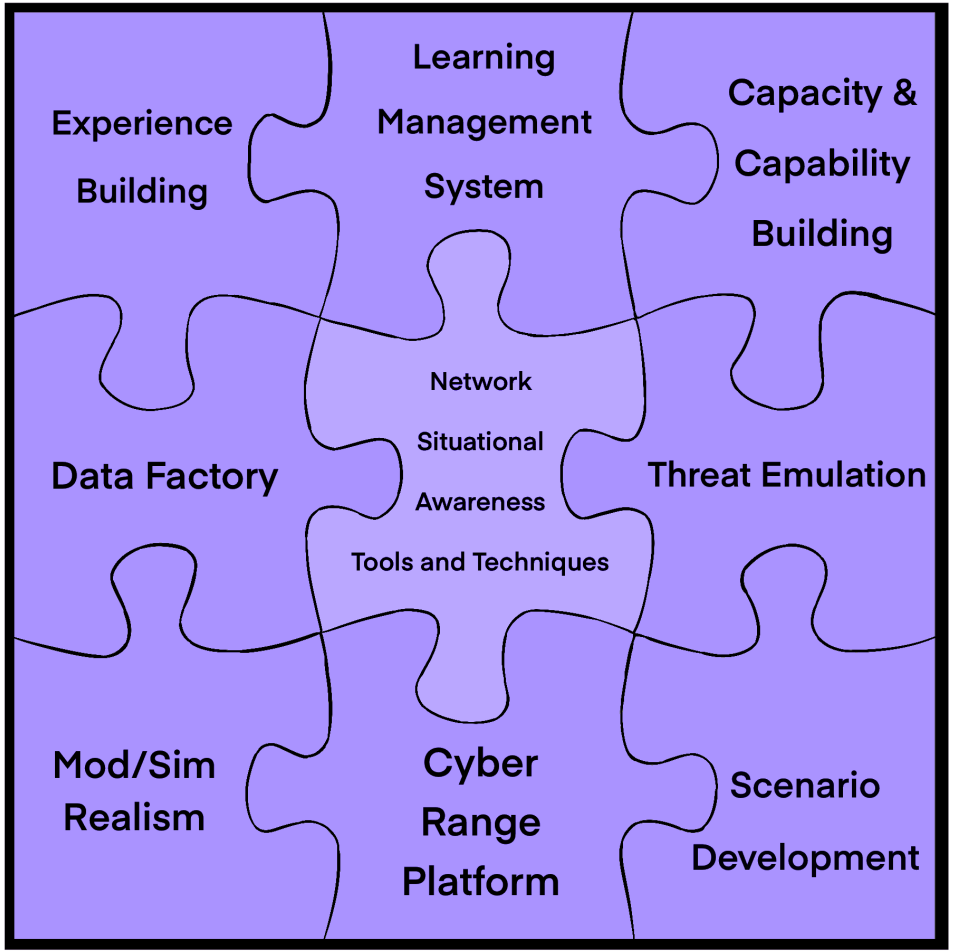
# What We Create

- Cyber ranges
- Virtual environments
- Relevant scenarios
- Typical network activity
- Emulated threat actors
- Learning experiences
- Testing environments
- Datasets

# What We Can Enable

1. Practicing on your available data sources
2. Challenging your threat hunting teams
3. Testing emerging technology
   - Edge Netflow
   - Zero Trust
   - Endpoint Detection and Response
   - Cloud
   - Artificial Intelligence / Machine Learning

# Where We Fit In…



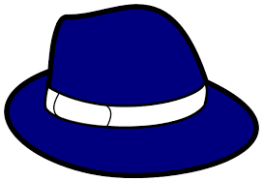
# Annual DoD Cyber Exercise Series 2012 - 2022

# DoD Cyber Exercise Program

- Fully customizable, highly realistic
- Nearly continuously funded since 2012
- Hundreds of exercises with thousands of participants over tens of thousands of exercise hours

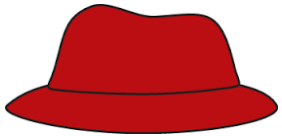
***= Deep cyber war exercise knowledge***

Cyber Range R&D, Tech Support



Role Play: Cyber Security Service Provider, Intel, Mission Owner, etc.

Scenario Design, Master Scenario Event List, Assessments



Role Play: Adversaries, Exploits

# 2022 Exercises

**Cyber Security Service Providers**
- 4-hour training exercises
- 8-hour certification exercises

**Cyber Protection Teams**
- 1-4 week training exercises
- 1-4 week APT emulation exercises

***42 exercises since February***

# Exercise Development Process

| Planning | Prep | Execution | Reporting |
|---|---|---|---|

Outputs:

- Exercise Charter
- Exercise Roster

Outputs:

- Cyber Cards
- Exercise Playbook
- Scenario Event List
- Participant Guide
- Network Validation
- Storyline Artifacts

Outputs:

- In-Game Artifacts
- Participation Report
- Exercise Assessment
- Dynamic MSEL

Outputs:

- Surveys
- After Action Reports
  - Team
  - CMU

# Building the Attack Space

# Range Topology Goals

- **Realism**
  - Align with commercial tools where possible

- **“Sufficient Complexity”:**
  - Hundreds of Windows 10 users / 13 subnet areas
  - Microsoft Active Directory & File services
  - Enclave hosted applications (portals, business process management, etc.) / DMZ’s

  - **Traffic generation**
    - Web browsing, file downloads, file sharing
    - User activity / logins/logouts
    - Endpoint protection and logging traffic

  - **Shared Internet space**
    - Point in time copies of the Internet and DNS zones
    - Geographically diverse adversary IP address space

- **Commercial software/tools**
  - ACAS / Nessus
  - Arcsight
  - Cisco ASA firewalls
  - Cisco Sourcefire / Firepower IDS
  - Virtual Cisco routers
  - Dell Quest Active Directory Change Auditor
  - F5 Proxy - TLS inspect
  - McAfee ePolicy Orchestrator
  - McAfee Network Security Monitoring (NSM)
  - Microsoft - Windows 10 / server 2016/2019
  - Splunk
  - Tychon
- **Open-Source software/tools**
  - Security Onion
  - Arkime (Moloch)
  - Elastic (ELK)

# Range Scenario Goals

- **Realism**
  - Align with **real world scenarios and intel**
  - **Library of cyber attacks / injects**
    - Seventy documented / ready to go (easy replay)
  - **APT emulation** timelines for attribution exercises
- **Full Exercise Team Participation**
  - Focus is not just technical
  - Battle captain leadership / fast pace
  - Refine team roles / workflow
  - **Increasing adaptability**
- **Cyber Data Science**
  - Continuous data source of realistic data embedded with malicious adversary activity

# CMU team responsibilities

- **Range infrastructure**
  - design / implementation / maintenance / upgrades
- **Cyber scenario development**
  - Research / develop / implement complex cyber attacks
- **Exercise control**
  - Scheduling / white cell moderation
  - Role play
    - **Higher headquarters**
      - Intel & task orders
    - **Red team**
      - Launch / control all attacks





**Remove all barriers so teams can focus on their mission**

- **Dedicated and persistent cyber ranges**
  - Every organization/team has their own range

- **Dedicated - availability**
  - 24x7 - during exercise season
  - Team scheduling flexibility

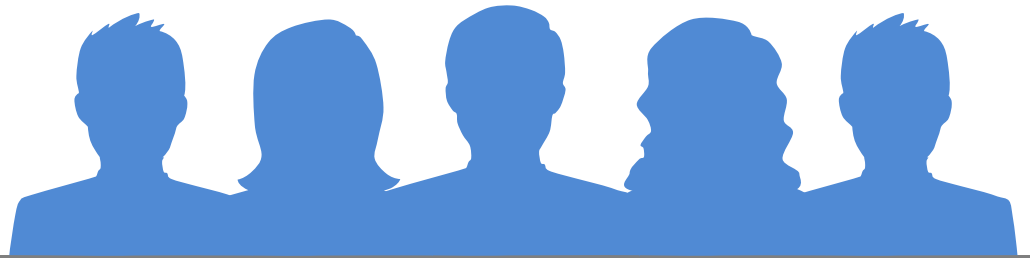
- **Persistence - range technical configurations**
  - **Baseline configs**
    - Active Directory users/groups
    - Microsoft Windows group policy objects (GPO)
    - Microsoft Windows and network event log aggregation
    - Network ACL's / firewall rules

**More team participant time for sophisticated tuning and hunting**

# An exercise contains interactions between:

- **Player**
  An active human participant

- **Non-player character (NPC)**
  Any character not controlled by a player within the exercise



# GHOSTS orchestrates realistic NPCs that:

- Are behaviorally accurate
  - (from harmless administrators to hostile nation-state attackers)
- Represent an infinite array of possible interactions
- Are fully-autonomous
- Match training realism with high training value
- Prepare cyber warfare teams for success in real-world situations

# Sydney Zackariah Deutschmann

Home | Education & Career | Insider Threat | Military Service | Relationships

**First name**
Sydney

**Last name**
Deutschmann

**Biological Sex**
Male

**Height / Weight**
74"/ 197 lbs.

**Blood Type**
O+

**Location**
07/18/1982

**Phone**
(390) 001-3019

**Mobile**
(061) 901-5625

**Primary Email**
sydney.zackariah.deutschmann.mil@mail.mil

**Password**
^w6]5<U%

## Addresses

### Home

350 Shirinlou Bridge Coffeeville, Mississippi 38922

## Default Workstation

**flag-18.local (192.168.244.52)**

sydney.zackariah.deutschmann / teasley.mil

## PGP Key

**sydney.zackariah.deutschmann.mil@mail.mil (*]n_Q96b)**

```
-----BEGIN PGP PRIVATE KEY BLOCK-----
Version: BCPG C# v1.8.6.0

lQHqBF8HVs8BBACJVmHBVXGAuSPZDBGgQX/90SgK57fSP2vx41j7NvPYrOcalFjq
9PU0gL6cYNx3E+8EXHpBYfN3Dyr7RSKpLsyh3Alb+wn/znneuCQ3tWJINMmgYYQH
```

```
-----BEGIN PGP PUBLIC KEY BLOCK-----
Version: BCPG C# v1.8.6.0

mIsEXwdWzwEEAIlWYcFVcYC5l9kMEaBBf/3RKArnt9l/a/HjWPs289is5xqUWOr0
9TSAvpxg3HcT7wRcekFh83cPKvtFlqkuzKHcAhv7Cf/Oed64JDe1Ykg0yaBhhAff
```

## CAC

CAC not on file

Build Details

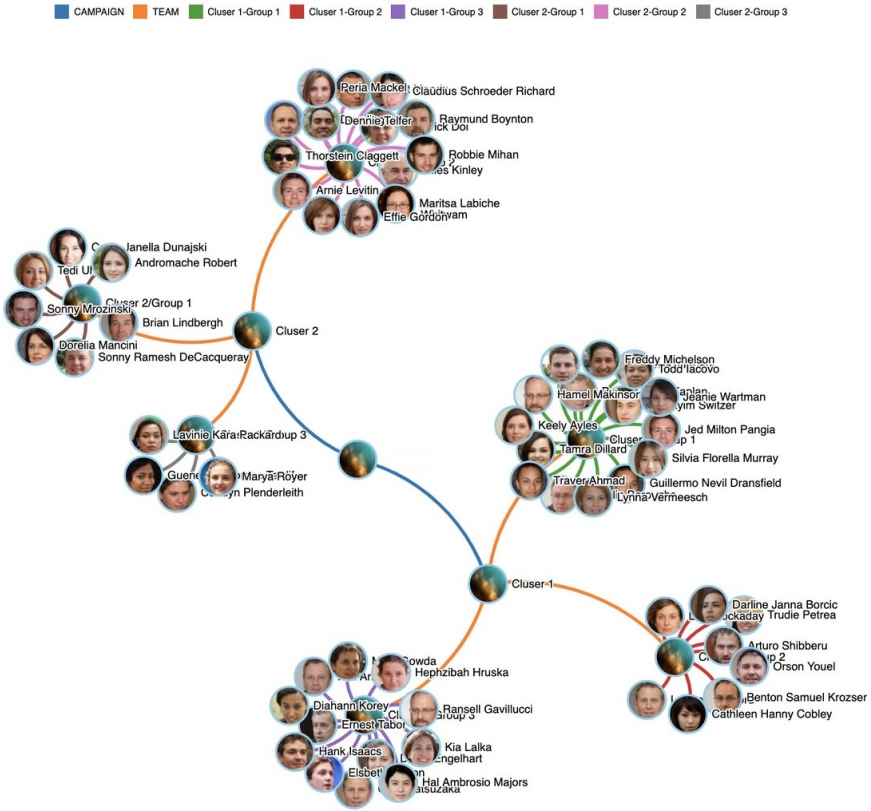
Created: 07/09/2020
Campaign: GCD 2021
Enclave: RCC-K
Team: INTEL

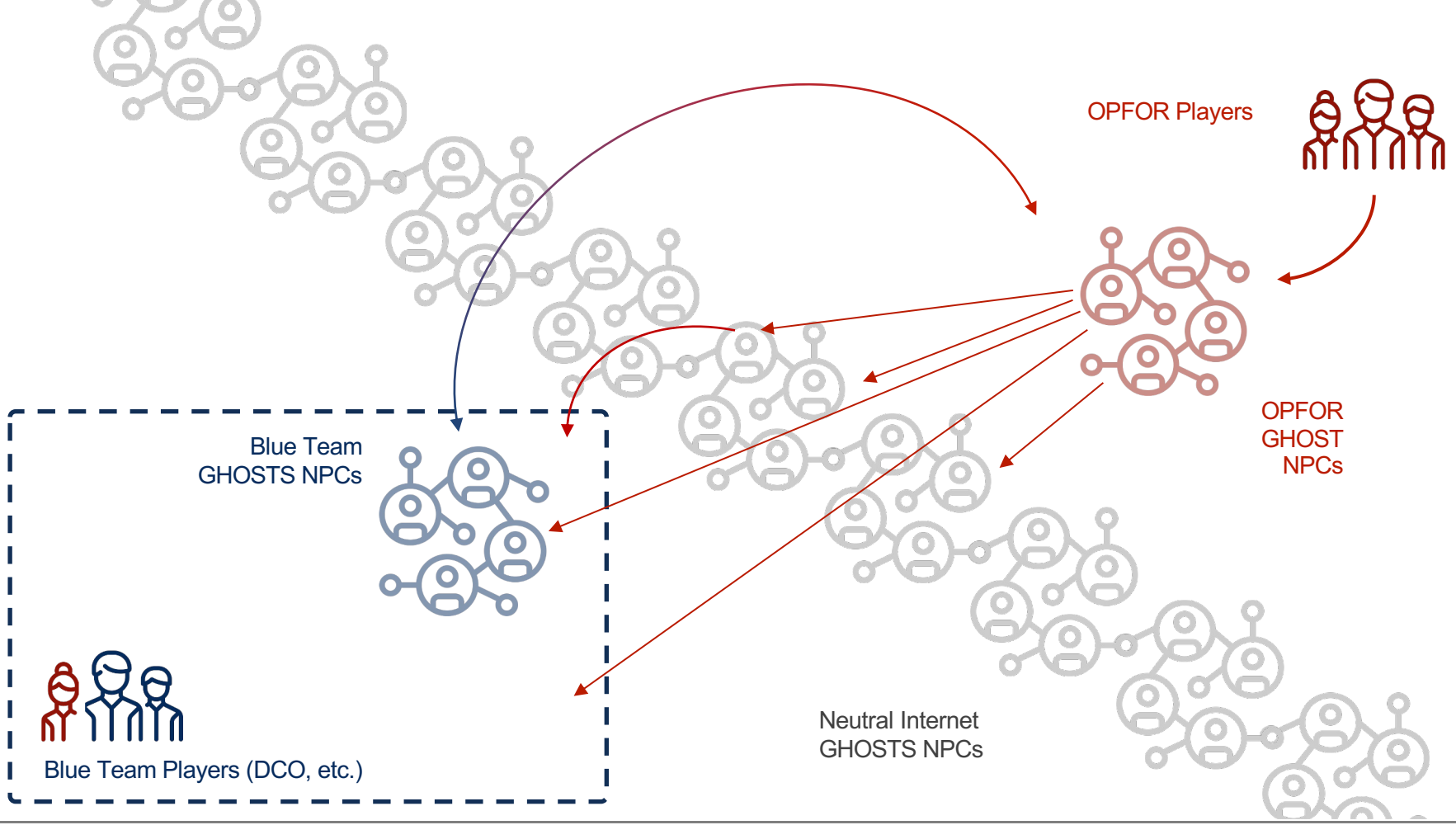
| Accounts | |
|---|---|
| sydneyzacka2481 | @Signal |
| Psychohobo | @Tumblr |
| sydneyzackariahdeutschmann | @gmail |
| sydn4385 | @Youtube |
| sydneyzackariahdeutschmann | @Facebook |
| sydneyzackariahdeutschmann8609 | @LinkedIn |
| sydneyzackariahdeutsc9418 | @Twitter |
| WillaryClinton | @http://gilstorf.us |
| try_to_cook_stuff | @http://coffey.uk |
| sydneyzackariahdeutschmann | @http://boehlke.biz |
| sydneyzackar6146 | @http://ashworth.com |
| sydneyzackariahdeutschm9733 | @http://feith.co.uk |

# Animator Build Relationships

A view of related NPCs generated from GHOSTS ANIMATOR ON Monday, 09 November 2020.

Build: 9c427e49-1eb0-46fa-9a9f-0805dce4456c





# Our Ecosystem

**CYBER-OPERATOR MONEYBALL**
"WHO IS GOOD AT WHAT" ML
2023

**Exercise Chat**
Admin/EO/Team comms
2023

**Range Events**
GHOSTS

**LRS**
Learning Locker

**HIVE**
OSS Security Incident Response Platform

**Inject Catalog** 😈
"A library of very bad things"

**CORTEX**
Observable Analysis & Active Response Engine

**Exercise Admin**
Range Notes

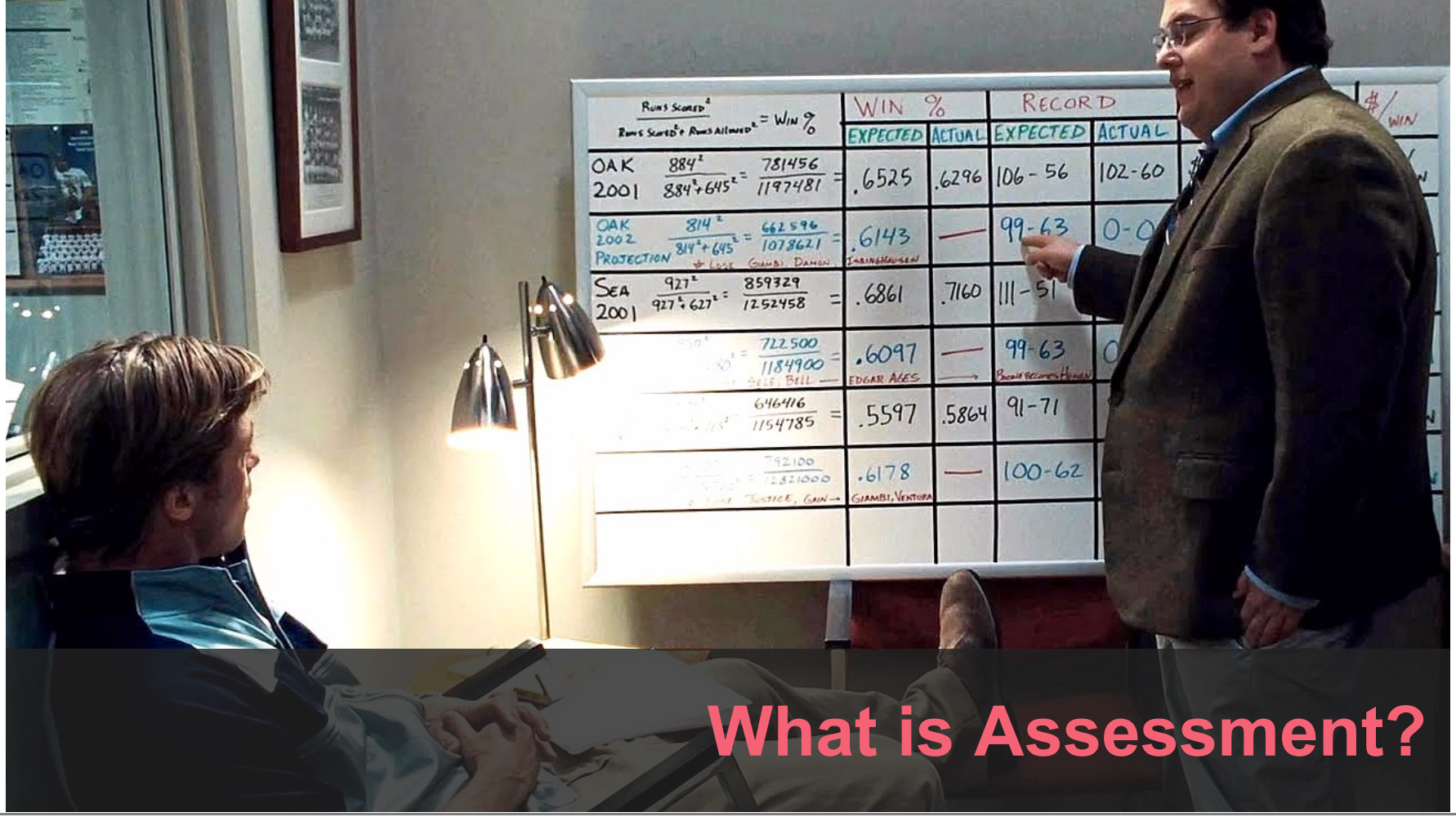
**External Assessor**
Assessment Score & Notes

PARTICIPANT SELF-REPORTING

MISP Threat Sharing

**MISP**
OSS Threat Intelligence Platform

**SEER**
Assessment Platform

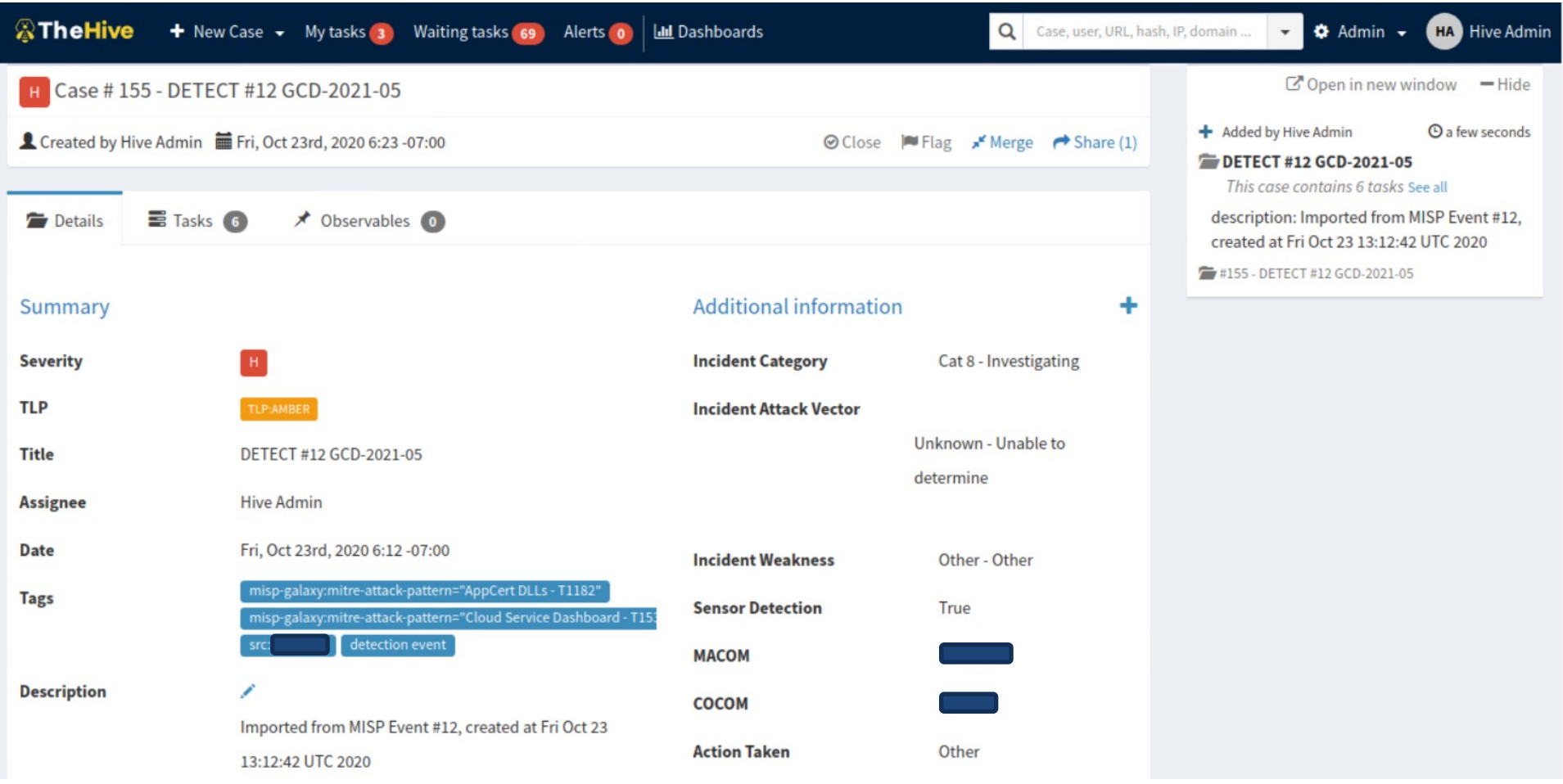



# What is Assessment?

# Assessment Challenges

How to identify:

- the highest performing teams?
- indicators/drivers of high performance?
- best practices from collected data?
- why some teams perform better?



# RCC-[redacted] - MC1 Deployment Timeline

| Time | Assigned | Event Description/Details | Execution Notes | Start | Complete | Status |
|---|---|---|---|---|---|---|
| +0:00 | [redacted] | Enable JWICS workstations on correct team | | (+0:00) | (+0:00) | |
| +0:00 | [redacted] | Comms Check<br>Start Zoom call<br>Comms check for chat groups / EO / HHQ / Nec Help Desk / Intel | | (+0:00) | (+0:00) | |
| +0:00 | [redacted] | Call STARTEX *20:06Z 14 OCT 2020* | | (+0:00) | (+0:00) | |
| +0:35 | [redacted] | CWD-2020-43 D'oh! - STEP 1<br>User browses to, downloads and installs Cobalt Strike Beacon<br>T1204 User Execution<br>Telemetry, User Behavior<br>Related Quiz Questions:<br>• Quiz 1: Question 4<br>• Quiz 1: Question 5<br>• Quiz 1: Question 6<br>Related EO Assessment:<br>• Conduct Defensive Cyberspace Operations:Conduct Cyberspace Operations (13-RCC-9000)<br>• Conduct Defensive Cyberspace Operations:Conduct Cyberspace Operations (13-RCC-9000) | +0:32 ADMIN [redacted]<br>Shifting Ops machine to 1.1 | (+0:34) | (+0:37) | |
| +0:35 | [redacted] | CWD-2020-43 D'oh! - STEP 2<br>Cobalt Strike Beacon connects to C2 via DNS over HTTPS<br>T1102 Command and Control - Web Service, T1071 Command and Control - Standard Application Layer Protocol<br>Telemetry Related Quiz Questions:<br>• Quiz 1: Question 4<br>• Quiz 1: Question 5<br>• Quiz 1: Question 6<br>Related EO Assessment:<br>• Conduct Defensive Cyberspace Operations:Conduct Cyberspace Operations (13-RCC-9000)<br>• Conduct Defensive Cyberspace Operations:Conduct Cyberspace Operations (13-RCC-9000) | +0:44 OBSRV [redacted]<br>Team had splunk mis-configured<br>+0:42 ADMIN [redacted]<br>Observed something related on the range | (+0:34) | (+0:37) | |
| +0:35 | [redacted] | CWD-2020-43 D'oh! - STEP 3<br>From C2, red operators execute ad-hoc commands on user workstation<br>T1041 Exfiltration - Exfiltration Over Command and Control Channel, T1048 Exfiltration - Exfiltration Over Alternative Protocol<br>Telemetry Related Quiz Questions:<br>• Quiz 1: Question 4<br>• Quiz 1: Question 5<br>• Quiz 1: Question 6<br>Related EO Assessment:<br>• Conduct Defensive Cyberspace Operations:Conduct Cyberspace Operations (13-RCC-9000)<br>• Conduct Defensive Cyberspace Operations:Conduct Cyberspace Operations (13-RCC-9000) | +0:38 IRESP Case #6 Created | (+0:34) | (+0:37) | |
| +0:40 | [redacted] | Quiz #1 In Process | | (+0:40) | (+0:40) | |
| +0:45 | [redacted] | CWD-2019-57 DNS Data Exfiltration<br>Data from NEC Users is exfiltrated using legitimate DNS queries | | (+0:42) | | |
| +1:25 | [redacted] | CWD-2020-43 Black Hole Memes<br>blackholememes.com installs a RAT on user machine | | | | |
| +0:55 | [redacted] | Quiz #2 Not Started | | | | |
| +3:15 | [redacted] | Call ENDEX | | | | |
| +3:15 | [redacted] | Turn off Cyclone traffic generation | | | | |

Add new timeline event

# What Value We Can Offer

# Value Proposition

Cyber Ranges

- DFARS Compliant
- PIV Authentication
- Open-Source Software
- Open Standards

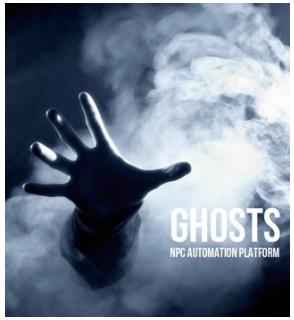
Expertise & Creativity

- Cyber Modeling and Simulation
- Threat Emulation
- Scenario Development
- Immersive Experiences
- Cybersecurity
- Threat Hunting

# To Learn More… Our Open-Source Software

## Crucible: A Cyber Simulation Application Framework

- Fact Sheet: https://resources.sei.cmu.edu/asset_files/FactSheet/2020_010_001_643855.pdf
- Code: https://github.com/cmu-sei/crucible
- Documentation: https://cmu-sei.github.io/crucible/
- Containers: https://hub.docker.com/u/cmusei




## GHOSTS Non-Player-Character Automation and Orchestration Framework

- Fact Sheet: https://resources.sei.cmu.edu/asset_files/FactSheet/2019_010_001_551085.pdf
- Code: https://github.com/cmu-sei/ghosts
- Documentation: https://github.com/cmu-sei/GHOSTS/wiki
- Containers: https://hub.docker.com/r/cmusei/ghosts

# To Learn More… Our Research Publications

## Technical Reports

- Dec 2021: Using Machine Learning to Increase NPC Fidelity
- May 2021: Foundation of Cyber Ranges
- Dec 2018: GHOSTS in the Machine: A Framework for Cyber-Warfare Exercise NPC Simulation
- Sep 2017: R-EACTR: A Framework for Designing Realistic Cyber Warfare Exercises

## Presentations

- Jun 2021: GHOSTS in the Machine: Orchestrating a Realistic Cybersecurity Exercise Battlefield

## Podcasts

- Oct 2022: ML-Driven Decision Making in Realistic Cyber Exercises

## Blogs

- Sep 2022: Using Alternate Data Streams in the Collection and Exfiltration of Data
- Apr 2022: Using Machine Learning to Increase the Fidelity of Non-Player Characters in Training Simulations
- Apr 2021: Generating Realistic Non-Player Characters for Training Cyberteams

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