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Dynamic Cybersecurity Training Environments for an Evolving Cyber Workforce

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Outline

- Introduction and Motivation
- Current Methods and the Status Quo
- The Benefits of Live Training
- Use-Case Study and Lessons Learned
- Conclusion

INTRODUCTION AND MOTIVATION

Introduction

- Global shortfall of 378K InfoSec staff, to increase to 1.5M by 2019
- Need: Real-world scenarios to include:
  - Defense techniques
  - Attack-based approaches
  - Adversary understanding/methodology
- Lack of standards exist to streamline training requirements

Introduction

- Secure computing environment training:
  - Testbeds → real hardware
  - Assess impact of breach
  - Eval strategies for new security capabilities
- However,
  - Expensive
  - Difficult to maintain
  - Time consuming to construct/deploy
  - Often single purpose

CURRENT METHODS AND THE STATUS QUO

Current Methods & the Status Quo

- First responders and cybersecurity pros
- Certs not enough, need for immersive training
  - Evaluation against objectives is key
- Comparable to pilots and solders; train like you fight (e.g., CDX)
  - High-pressure, combative situations
  - Need to tie back to the mission and goals
- LVC + CDX

THE BENEFITS OF LIVE TRAINING

Live Training

- Cyber Training Platform Requirements
  - Hosts
  - Network System Architecture
  - System Security Mechanisms/Applications
  - System Load/Traffic Generation
  - Malicious Intrusion/Cyber-attack

Live Training

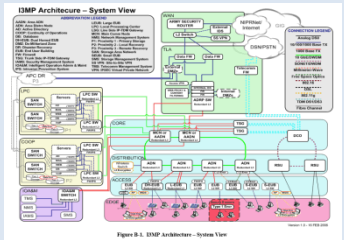
- Perceived Gaps, Limitations and Opportunities
  - Training environments do not adequately represent operations systems.
  - Training environments are often stuck in the contexts they were developed in and stale quickly.
  - System maintenance of a virtual training environment is too much work.

Live Training

- Modularity and modality
  - Appliance training
  - Specific task reinforcement
  - Targeted scenarios
  - Certification/technique training
  - Team studies

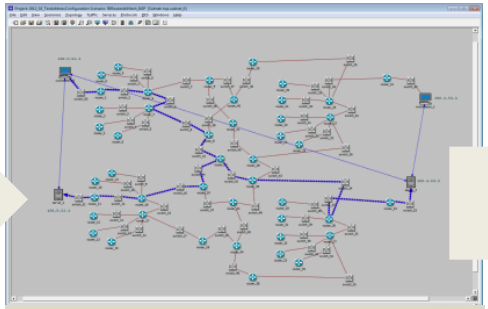
Live Training LVC

Specification information:
- Device configurations
- Network architecture
- Typical architecture

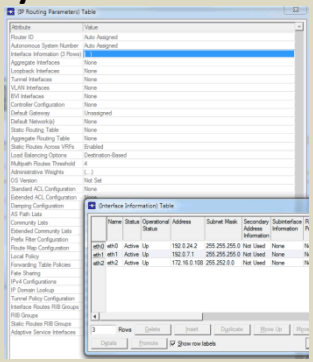


Discovery
- Traceroute
- Third-party tools
- Port mapping / scans
- SNMP
- L2/L3 Discovery
- Operational data (LLDP, CAM Table, ARP)

Design Estimation
- Design tools
- Best Practices
- Mission / Purpose
- Time



Produce model with full complexity of desired system



Identify OS Types

Test operation of specification in simulation
- Reachability
- Routing
- Firewalls

Modify as necessary to meet modeling purpose

Create outputs to compare to emulation model outputs for validation

USE-CASE EXAMPLE AND LESSONS LEARNED

Use-Case Study

- Sandia partnered with customer to create "fight through" training environment
  - Focused on network defense / hunt
  - Comprised of physical/virtual infrastructure; three network enclaves

Use-Case Study

- Three training zones:
  - α-Zone (SNL)
    - Emulated DMZ security stack (IDS, FW,)
    - Enterprise services (DNS, email, web)
  - β-Zone (SNL)
    - Bridged alpha and gamma zones
    - Emulated global internet, ICS, and Enterprise Network
  - γ-Zone (customer)
    - Landing/entry zone on-prem
    - L2TP to SNL zones

Use-Case Study

- High-fidelity & Interactivity
  - Physical/Virtual routers/switches
    - True switching/routing protocols
    - Engineered QoS (latency) on long-haul
  - VM Snapshot / Write-through
  - In-network services (IM, bulletins)
  - Vulnerable endpoints/services
  - VNC Replay / Artificial traffic generation
  - Dynamic “drop-in” VM/Users

Use-Case Study

- Data Collection
  - VM introspection from hypervisor
  - Mouse/keyboard from framebuffer (VNC)
  - Network flow and packet capture
- SNMP capture (e.g., CAM, performance, routes)
- VM agents (e.g., SplunkForwarder)

Lessons Learned

- Granular instrumentation provides “what” – extrapolation to answer other questions is more difficult
  - “Why” actions were done, and what were the residual effects?
    - Event correlation → causality analysis
    - Future effects? Motivations?

Lessons Learned

- Decision branches
  - Within the “cyber cockpit”
    - Student pass/fail at instances
    - State snapshot, scenario replay
    - Start/Stop/Resume
    - Choose-your-own adventure → realtime, automated scenario development
    - Behavioral input & analysis

Lessons Learned

- Measures of Effectiveness (MOE)
  - Training teams must understand their roles, tasks and how actions supported/impeded the overall mission
  - MOEs that determine ‘mission accomplishment’ and the tests/objectives in the scenarios
  - Individual MOEs vs Team MOEs
  - All detrimental to further implementing policy, developing TTPs, analyzing information and feedback to trainers.

CONCLUSIONS

Conclusions

- Need for foundational tools for CPTs to practice/hone/learn new skills is needed.
- “Train as you fight”
- Physical vs LVC
- Not enough to just craft the environment or know the what’s
  - Need for MOE and feedback loops

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Questions/Comments

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