Signal Week
US Army NETCOM

SEI Overview

Brian D. Wisniewski

11 June 2012

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Agenda

Introductions

- Software Engineering Institute (SEI) Overview

Virtual Training Environment & XNET Overview

Scenario Introduction & Overview

Exercise Login and Orientation to the XNET Interface

Exercise Execution

Wrap-up and Conclusion

Software Engineering Institute (SEI)

The SEI is a Federally Funded Research and Development Center (FFRDC)

Sponsored by the U.S. Department of Defense (DoD), it was created in 1984 and is administered by Carnegie Mellon University. It is a DoD R&D Laboratory.

Headquartered in Pittsburgh, Pennsylvania; the SEI provides support worldwide:

- 195 STE
- $150M annual revenue
- 600 employees

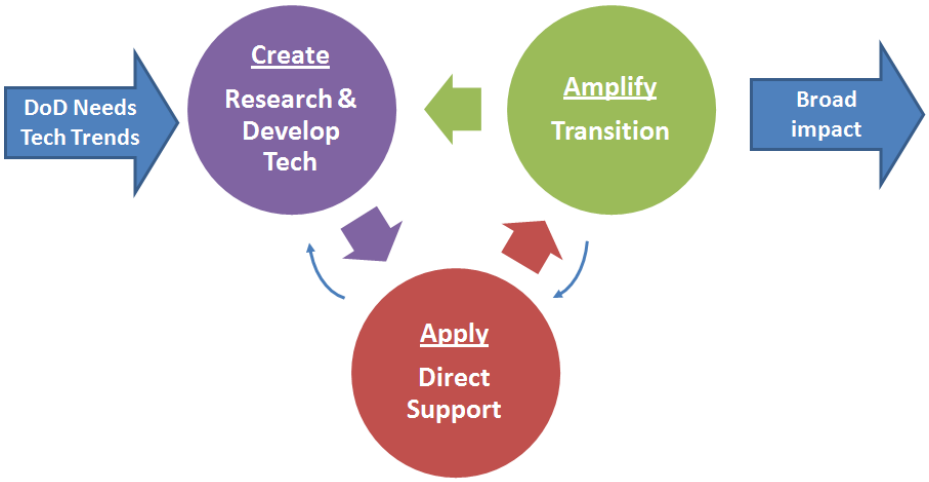
Mission and Strategy

Mission

The SEI provides technical leadership and innovation through research and development to advance the practice of software engineering and technology in support of DoD needs.

The SEI advances software engineering and related disciplines to ensure systems with predictable and improved quality, cost, and schedule.

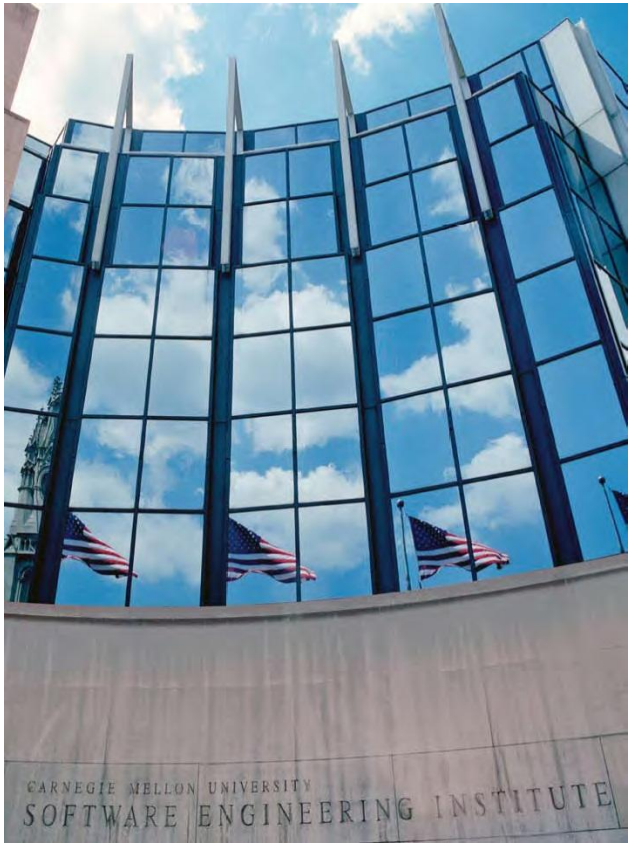
Strategy



SEI Objectives

The SEI works to:

- Identify, research, evaluate, and advise on software engineering technologies, trends, and practices.
- Collaborate with and leverage work found in industrial research, academia, and government laboratories.
- Mature promising software engineering technologies to enable standards, transition, and adoption within the DoD community.
- Enable government and industry organizations to make measured improvements in their software engineering practices.



A Broad Range of Stakeholders

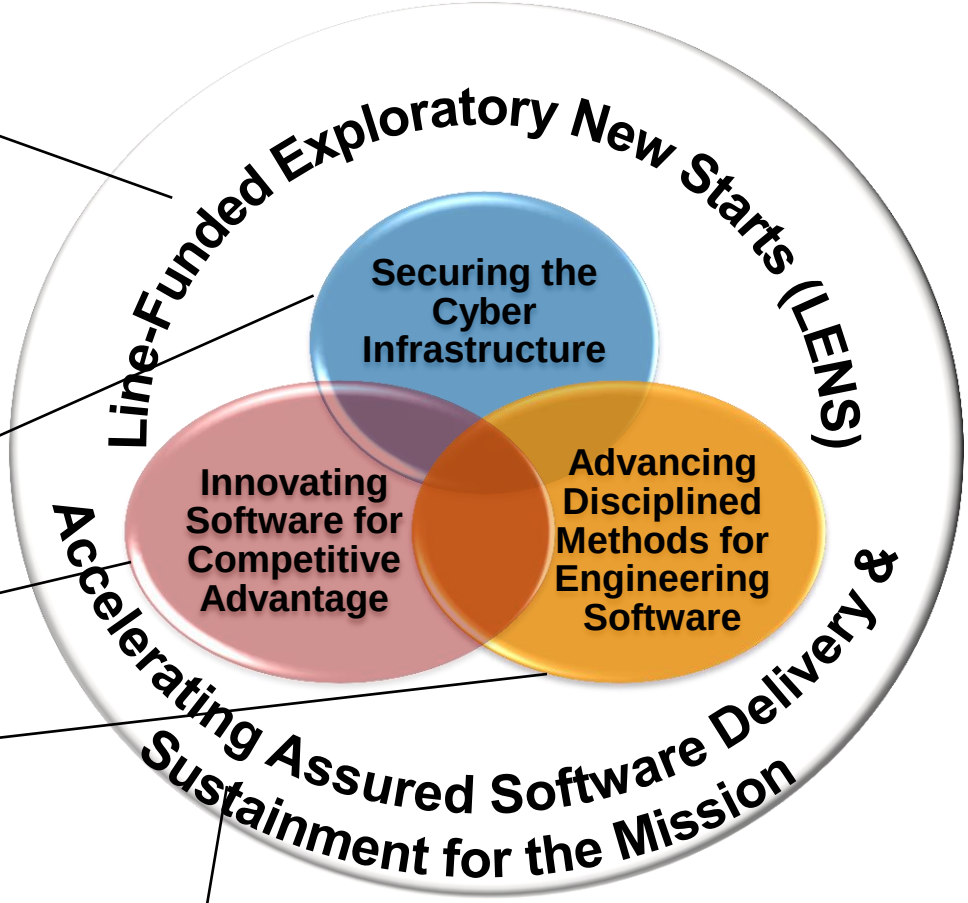
The SEI advances research in software engineering and cyber technologies for its many stakeholders:

- Major government customers and sponsors
  - U.S. Department of Defense (DoD)
  - U.S. Department of Homeland Security (DHS)
- Researchers, developers, users, and acquirers—government, commercial, and academic
- Key industries and organizations with the potential to advance software engineering and related disciplines
- Strategic partners worldwide

SEI's Technical Strategy for Software-Reliant DoD Systems

Exploratory activities to identify risk/reward potential as a sustained research initiative (~1 year initial duration)

Sustained research initiatives (~3-4 year duration, depending on progress against measures of success reviewed annually)



Application of research to practice in acquisition programs & DoD/IC domains

EXPLORE | CREATE | APPLY | AMPLIFY | SUSTAIN

Key Capabilities & Core Competencies

The SEI researches & develops practices & methods in software engineering & related disciplines, applies them to real problems, & transitions them for broad impact.

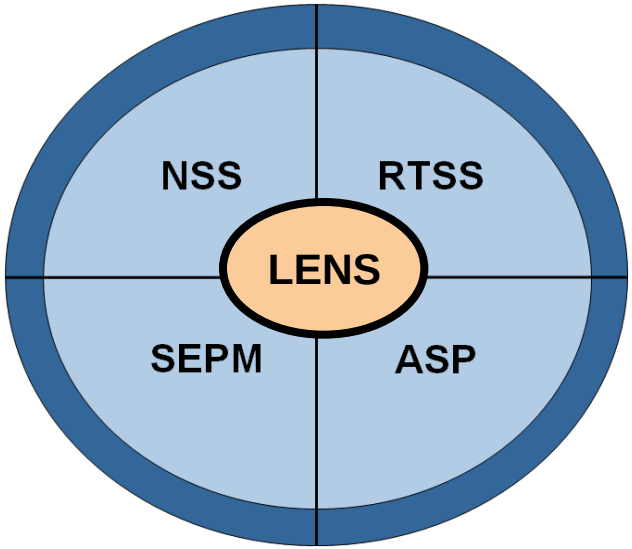
The core competencies of the SEI are:

- *Process & Measurement*
  - Software development process and lifecycle
    (Planning, Requirements, Design, Coding, Testing, Verification, Validation, Sustainment/Support)
  - Cost estimation
  - Performance measurement
  - Producibility
  - Technical risk analysis & mitigation
- *Architecture*
  - Reengineering & reuse
  - Maintainability, changeability, & evolvability
  - Embedded software
- *Assurance & security*
  - Reliability
  - Security, safety, survivability, & timing
  - Cyber software assurance & forensics

Technical Program Alignment and Areas of Focus

Securing the Cyber Infrastructure

Innovating for Software Superiority



Advancing Disciplined Methods for Software Engineering

Accelerating Assured Software Delivery for the Mission

NSS	Networked Systems Survivability Program
RTSS	Research, Technology, & System Solutions
ASP	Acquisition Support Program
SEPM	Software Engineering Process Management Program
LENS	Line-funded Exploratory New Starts

SEI Structure

Director and CEO
Paul Nielsen

Chief Operating Officer
Peter Menniti (Acting)

Chief Technology Officer
William Scherlis (Acting)

Acquisition Support Program Interagency and Cyber
Exec. Director: T. Roberts
Deputy: M. Ward

Networked Systems Survivability
Director: R. Pethia
Deputy: W. Wilson

Research, Technology, and System Solutions
Director: L. Northrop
Deputy: M. Klein

Software Engineering Process Management
Director : A. Carleton

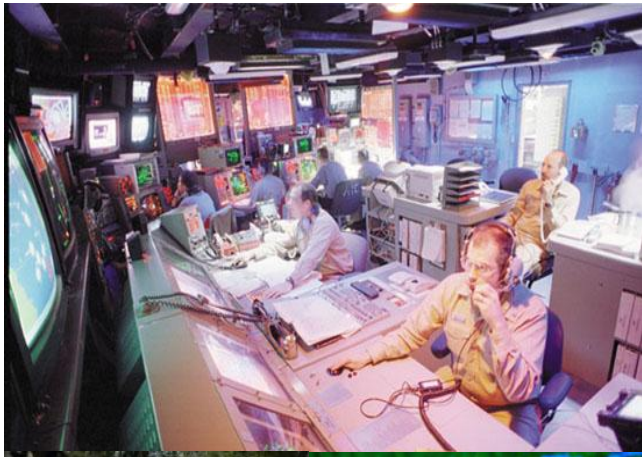
Information Technology
Director: D. Thompson
Deputy: S. Kalinowski

Financial and Business Services/Administration
Director: P. Menniti
Deputy: H. Kaye

Program Development and Transition
Director: J. Bramer
Deputy: S. Cunningham

Areas of Active Research and Development

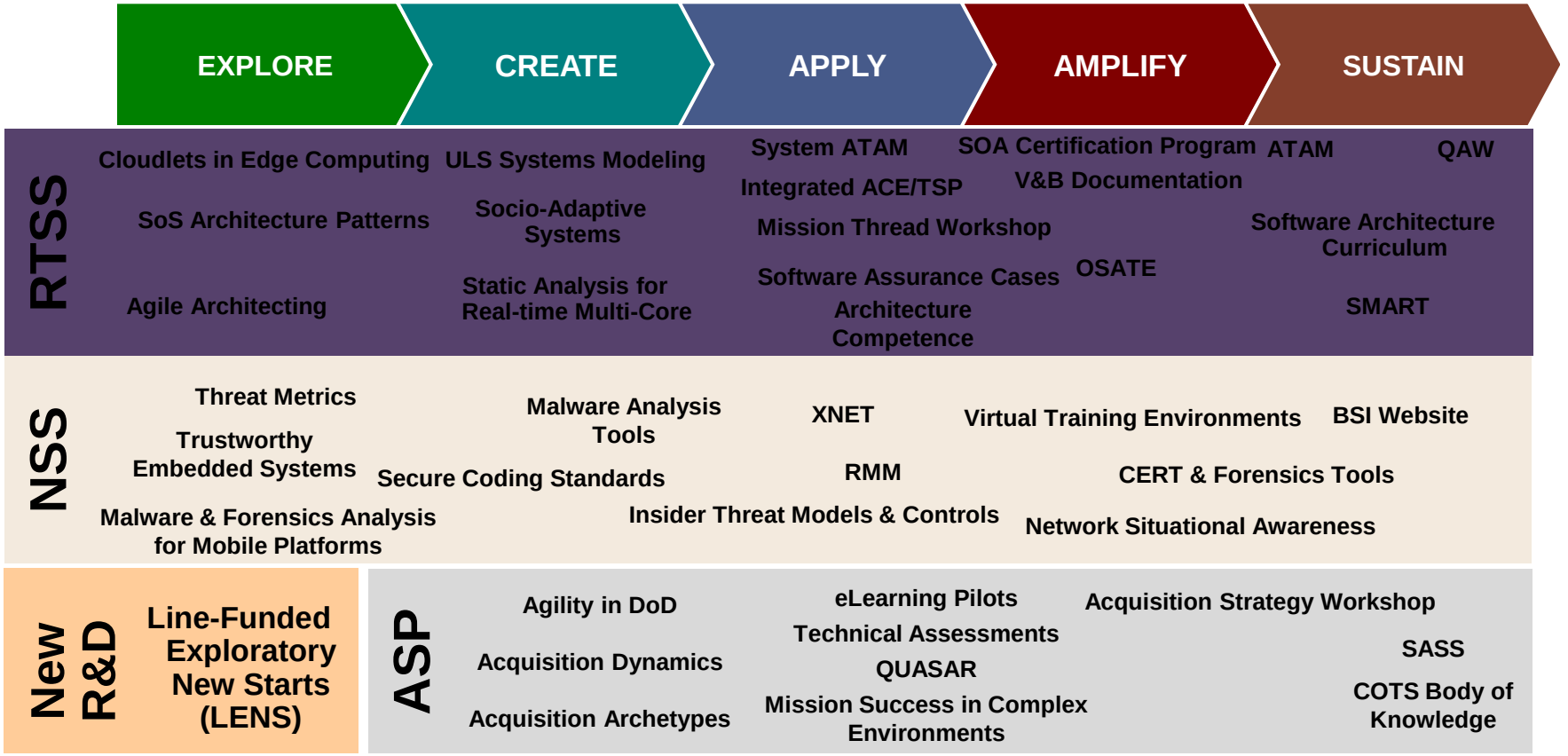
- Models and Guidelines for Agility in DoD
- Acquisition Dynamics
- Static Analysis for Real-time Multi-Core
- Agile Architecting
- Edge Programming for Mobile Platforms
- Software Assurance Argumentation Theories
- Secure Coding Patterns for C, C++, and Java
- Malicious Code Detection and Analysis Techniques
- Trustworthy Embedded Systems
- Digital Investigations and Video Exploitation Gap Area Tools
- Socio-Adaptive Systems
- Probabilistic Modeling of Uncertainties in LCC
- Integrated, Lightweight, and Agile Life-Cycle Models
- Detection of Anomalies in DOD Data Repositories



Customers & Stakeholders – Military Services

Services		
Air Force	**Army**	**Navy**
SAF/AQX SAF/AQR JMPS GEMS MMP Upgrade 3DELRR C2AOS JMS AF/A1 SOA DoD NextGen Chief Architect Support FAB-T, PMAG and EELV study GPS III satellite and OCX N-CSDS Global Hawk GSRA and UCS ORS SAF/A6 AFRL AFOSR NASIC	ASA/ALT (ASSIP) AMRDEC SED Army Materiel Command ARDEC SED CECOM SEC CERDEC C2C HQDA G6/CIO PdM NetOPS (PM WIN-T) PdM Army Enterprise Systems Integration Program PEO Aviation PEO Soldier PM Battle Command PM FBCB2 PM Heavy Brigade Combat Team PM Integrated Air and Missile Battle Command System PEO Integration	DDG-1000 EFV (Expeditionary Fighting Vehicle) F/18 F35 PEO Integrated Warfare Systems PEO SUBS Submarine Warfare Federated Tactical System (SWFTS) PMS 485 (Maritime Domain Awareness) SPAWAR Systems Center – Charleston NAVAIR NAVOCEANO Navy Cyber Defense Operations Command (NCDOC) Communications Satellite (PMW 150)

The SEI is a Knowledge Pipeline: From Research to Transition



Summary

25+ year history of contributions and innovation

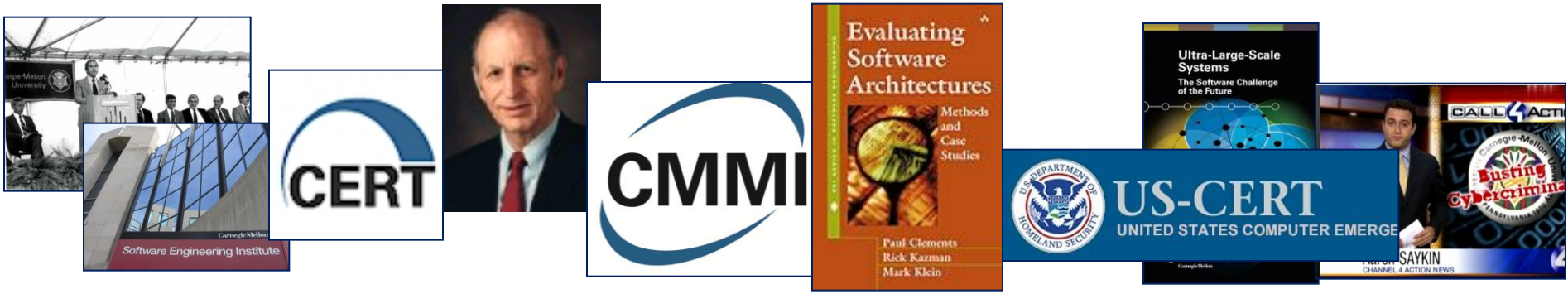
World leader in software engineering research and transition

Strategic emphasis on enhanced impact

Current technical program spans acquisition, technical, and management practices

Positioned for future challenges

- Extending current technologies
- Exploring new technologies



Additional Briefings

Software Engineering Institute (SEI) Overview

CERT Cyber Threat & Vulnerability Analysis Overview

CERT Cyber Enterprise and Workforce Management Directorate Overview

Cyber Mission Assurance Overview

CERT Program

Mission

Anticipating and solving our nation's cyber security challenges

Vision

A securely connected world

Strategy

Research, develop, transition, and support new security enhanced:

- software and system development technologies and practices
- system and network monitoring and management technologies and practices
- digital investigations and intelligence methods and tools

Anchor research and development efforts in operational challenges and realities

Pilot and prototype with strategic customers to set realistic transition paths

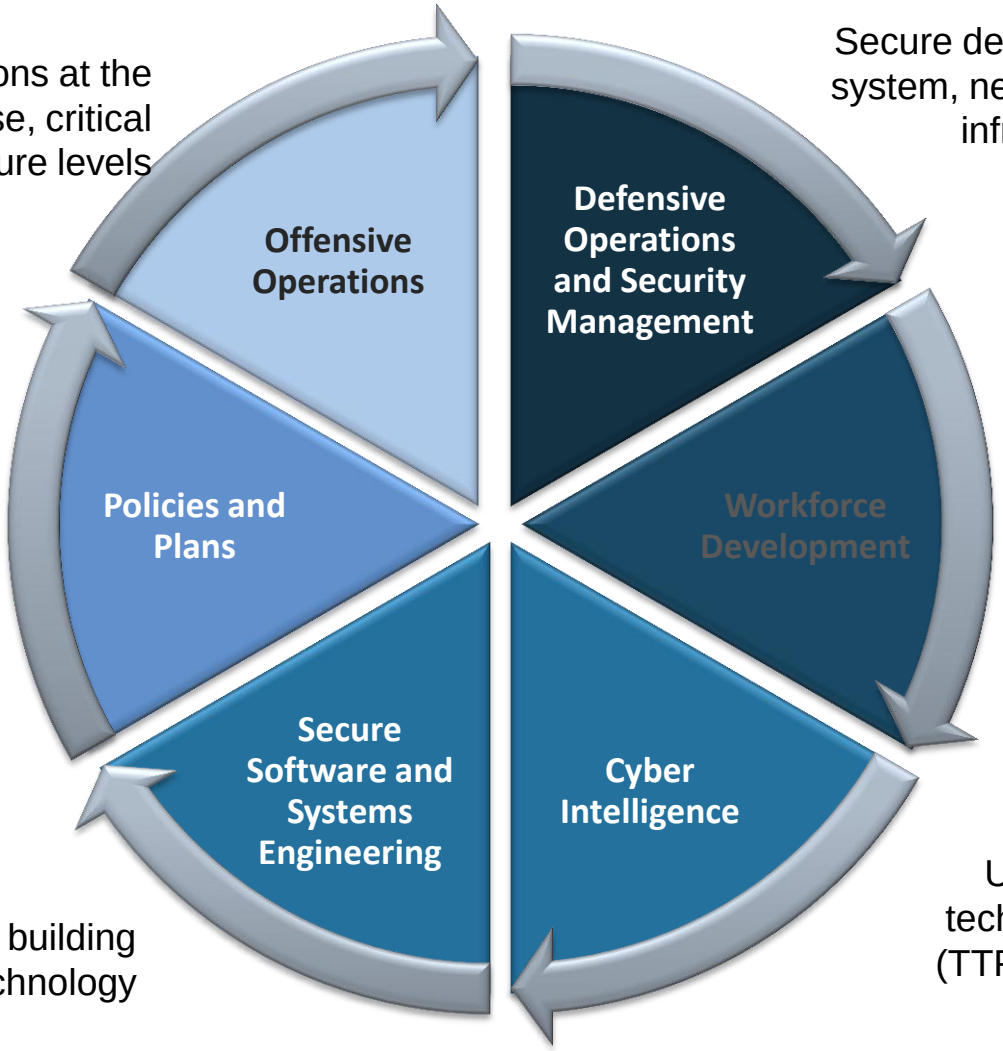
Goal

To reduce the opportunity for and impact of cyber attacks

Cyber Security and Assurance *Key Components*

Offensive cyber operations at the system, network, enterprise, critical infrastructure levels

Secure defensive operations at the system, network, enterprise, critical infrastructure levels



Security policies and plans

Workforce has the right knowledge, skills, abilities to conduct cyber missions and develop secure systems

Art and science of building securable technology

Understand the tactics, techniques, and procedures (TTPs) of the community and adversary

Research Challenge in Cyber Security

Threats at Scale in number and time

- Adversaries can affect millions of connected objects in very compressed time frames
- Immense attack surfaces: computers, applications, services, networks, routers, users, physical control connections, databases, business operations, etc.
- Sub-second timescales for attacks, responses, situational awareness

We don't know yet how to effectively deter, prevent, detect, respond in a way to mitigate important threats at scale.

- How to acquire, design, build, compose, and operate software components and systems to support the survivability of the mission.
- How do we ensure that future generations of technology will better protect our critical systems and not inhibit innovation, agility, resiliency?
- We're making progress, but the gap is a national security issue

CERT's research approach

- Exploit data collected to mitigate threats and attacks.
- Exploit data collected to inform development of secure/resilient software, systems, networks, services, etc.
- Develop scalable cyber-security forensics
- Share data and experiences

CERT Program Organization

Secure Software and Systems	Develop technologies to embed software and system assurance in all aspects of the system development life cycle.
Cyber Enterprise & Workforce Development	Establish the routine use of disciplined approaches to improve enterprise survivability and resiliency; provide security practices and information assurance training and education.
Cyber Threat and Vulnerability Analysis	Discover and resolve vulnerabilities in software products; improve cyber-tradecraft analysis; quantitatively assess potential threat and subsequent impact of malicious activity.
Digital Investigations and Intelligence	Research and Develop gap area technologies to advance the state of practice of digital exploitation and analysis.

Secure Software and Systems

Develop and adapt practices, processes, tools, techniques, and measures to address security and survivability in every phase of the development and acquisition life cycle

Motivation:

- Threats to DoD systems evolving
- Potential for crippling attacks
- Dependence on large-scale, complex, software dependent systems
- Early decisions in Acquisition & Development have major impact on security

Primary areas of work:

- Address security across the software engineering life-cycle to improve security properties
- Software and System development technologies and practices
- Embedded system safety, security, and survivability

Secure Software and Systems Organization

Cyber Security Engineering

- Acquisition and Development Practices
- Software Assurance Education
- Supply Chain Risk
- Security Measurement and Metrics

Secure Code Initiative

- Code Construction
- International Standards
- Code Analysis
- Analytical Tools, Methods, and Practice

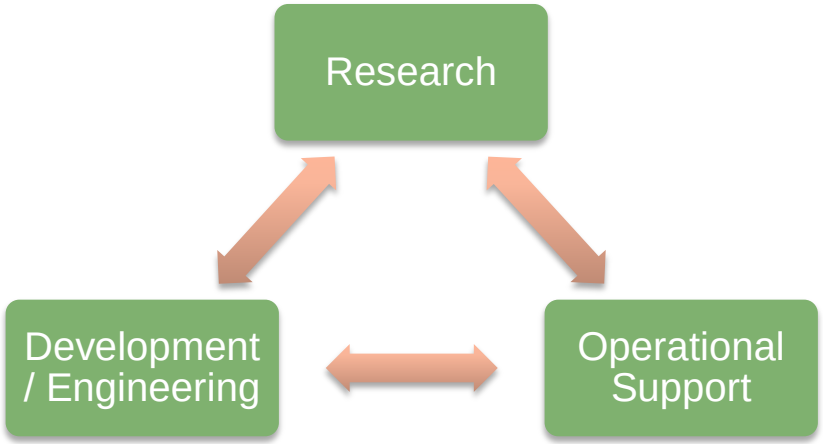
Next Generation Security Mechanisms

- Trustworthy Embedded Systems
- Survivable Infrastructure

Digital Intelligence and Investigations

The Digital Intelligence and Investigation Directorate continuously searches the horizon for the digital investigative challenges of tomorrow. Our position at the nexus of law enforcement, intelligence, industry, and research allows us to maintain a forward perspective on the potential challenges of the future.

- **We administer direct operational support to key customers, and focus our applied research capabilities to solving critical gap areas problems and limitations.**
- **We provide highly specialized computer forensics and incident response "gap area tools" not addressed by commercial tools or standard techniques to the DOD and US Federal Civilian Law Enforcement Agencies.**



Advantage

- Consistent identification of emerging challenges
- Access to data otherwise impossible
- USG gains access to rapidly prototyped capabilities
- Clear understanding of limitations with: commercial technology; training gaps; and techniques.
- Amplified transition directly to operational units combating adversaries

Notices

This material is based upon work supported by the U.S. Department of Defense under Contract No. FA8721-05-C-0003 with Carnegie Mellon University for the operation of the Software Engineering Institute, a federally funded research and development center.

Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the United States Department of Defense.

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CERT™ Cyber Threat and Vulnerability Analysis

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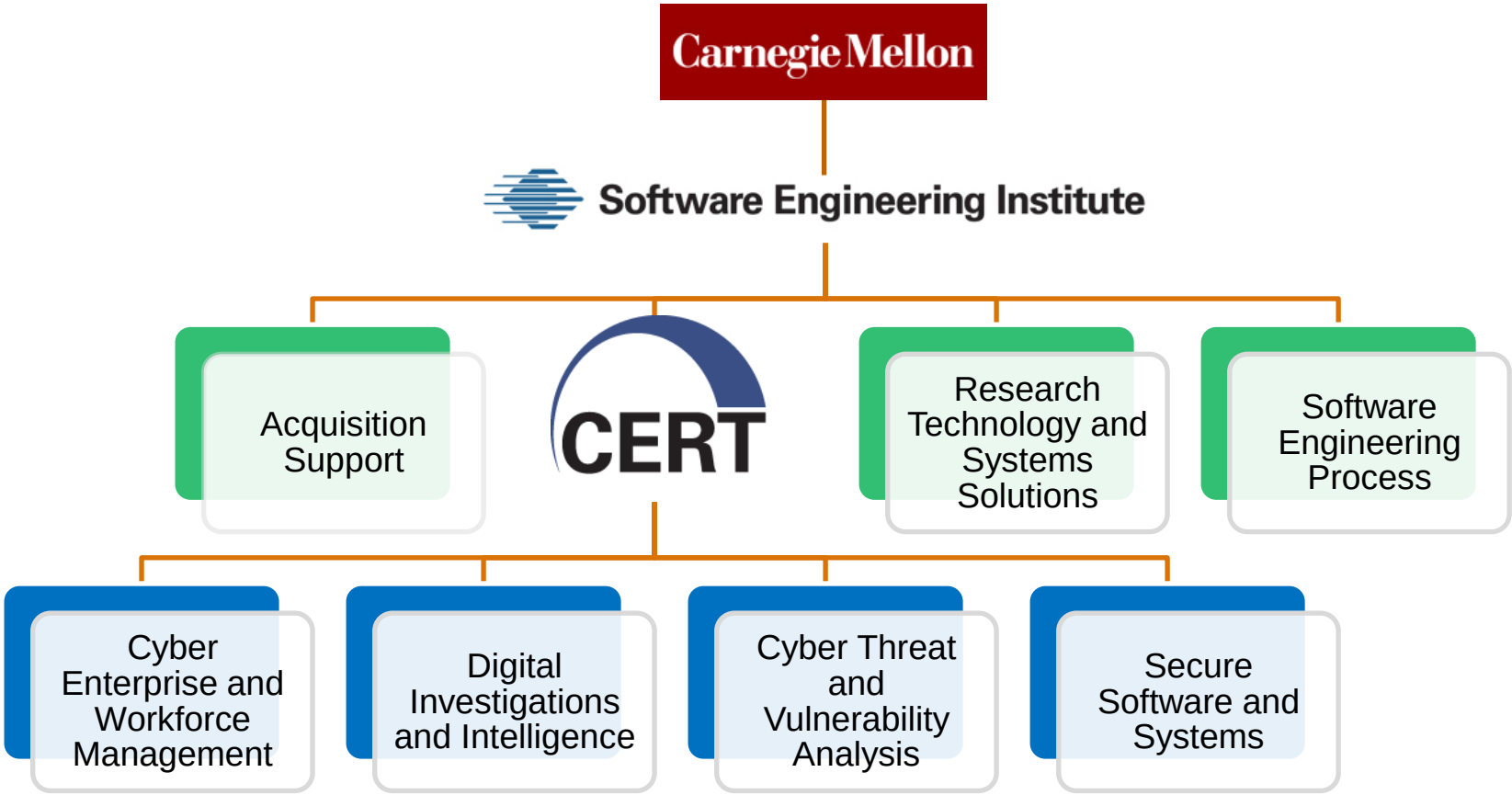
CERT Program

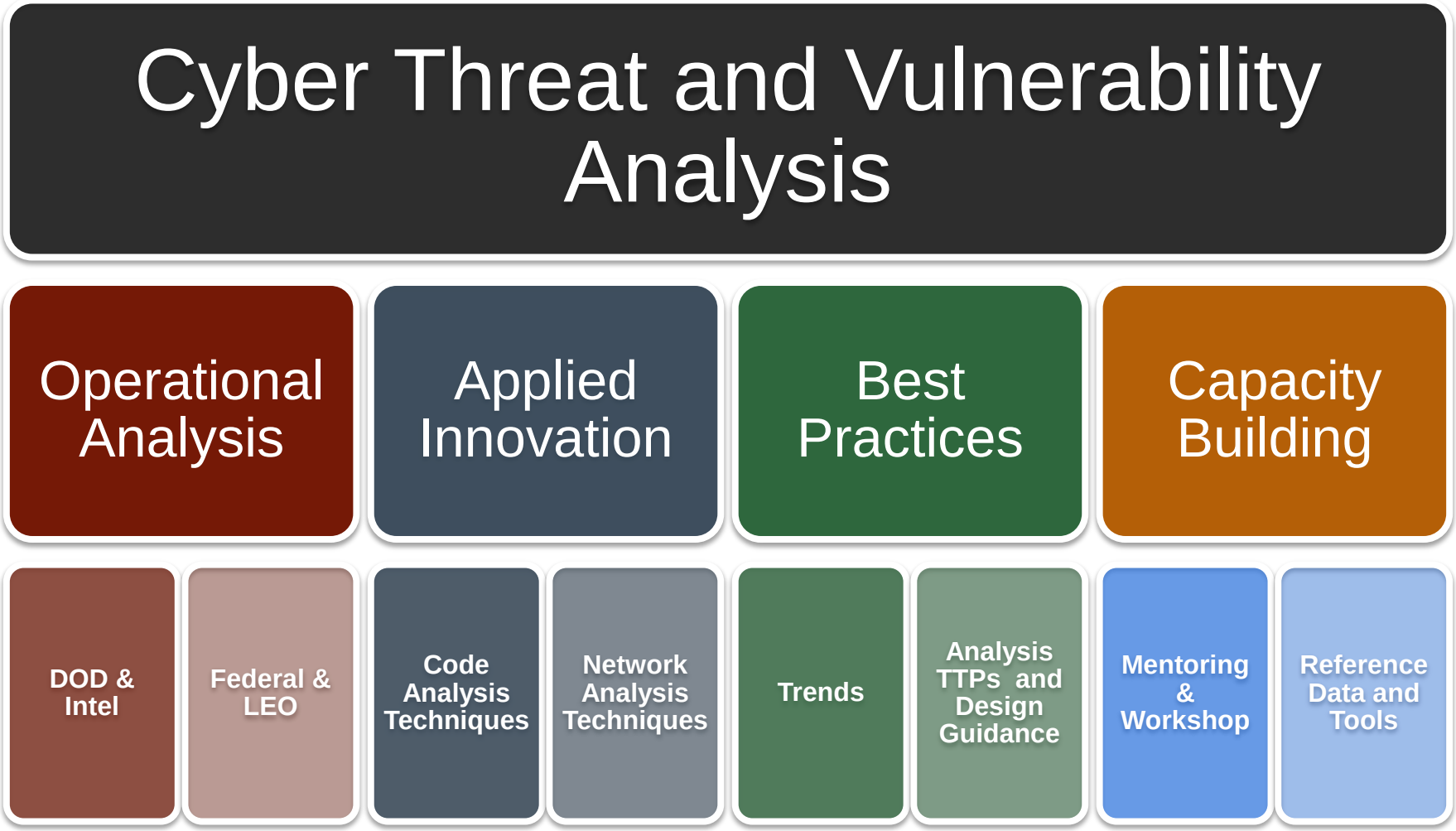


Cyber Threat and Vulnerability Analysis

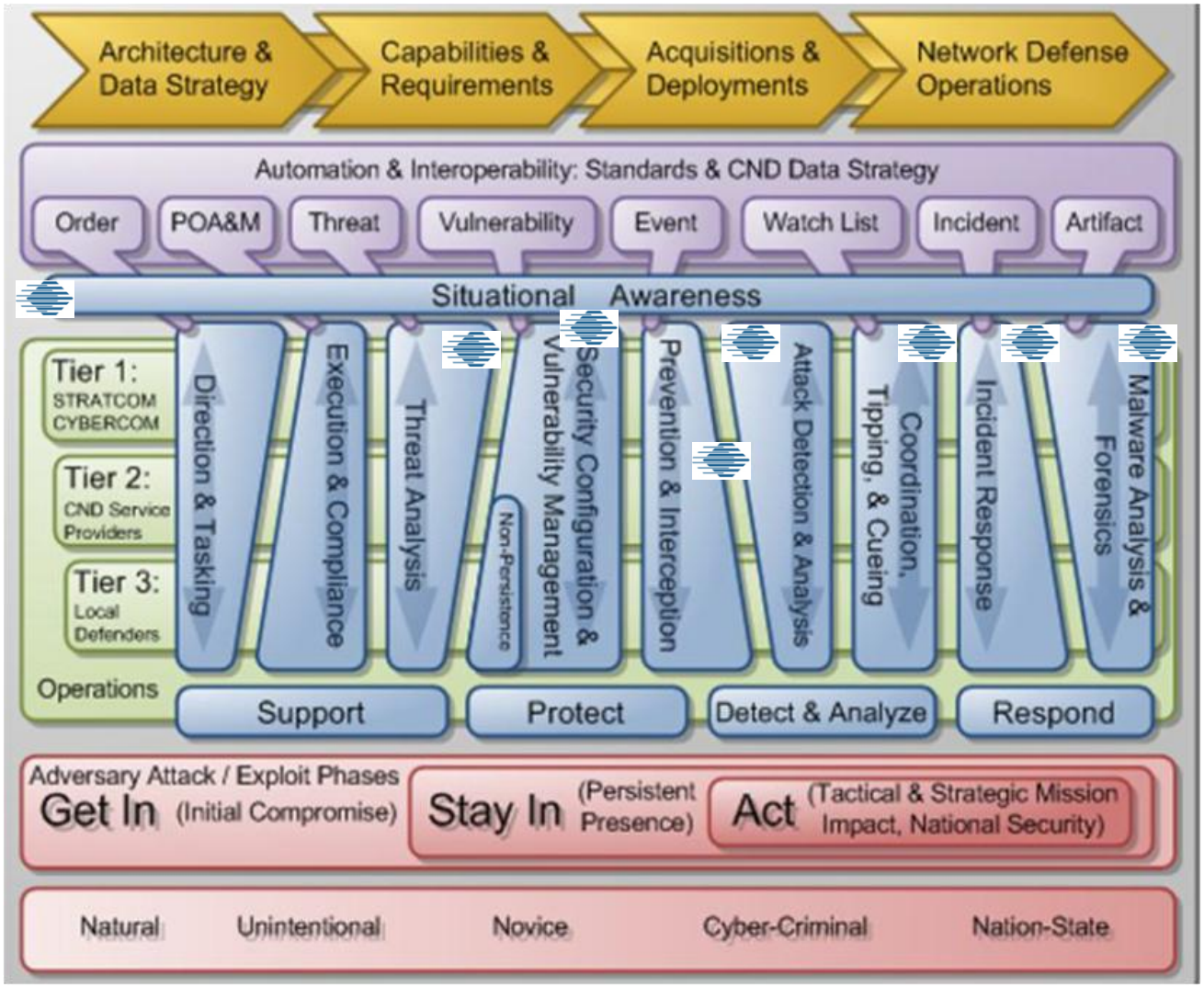
Perform, improve and grow capacity in:

- "Tier-3" analysis for USG cyber operations
- Test, evaluation, review and workflow of cyber-security-enabling technologies for USG operations and program offices
- Cyber operations in Critical Infrastructure and Key Resources (CIKR)

CTVA Functional Breakdown



DOD CND Architecture



DOD CND Architecture OV-1, NSA, June 2010

Areas of Work

Malicious code analysis

Critical infrastructure incident analysis

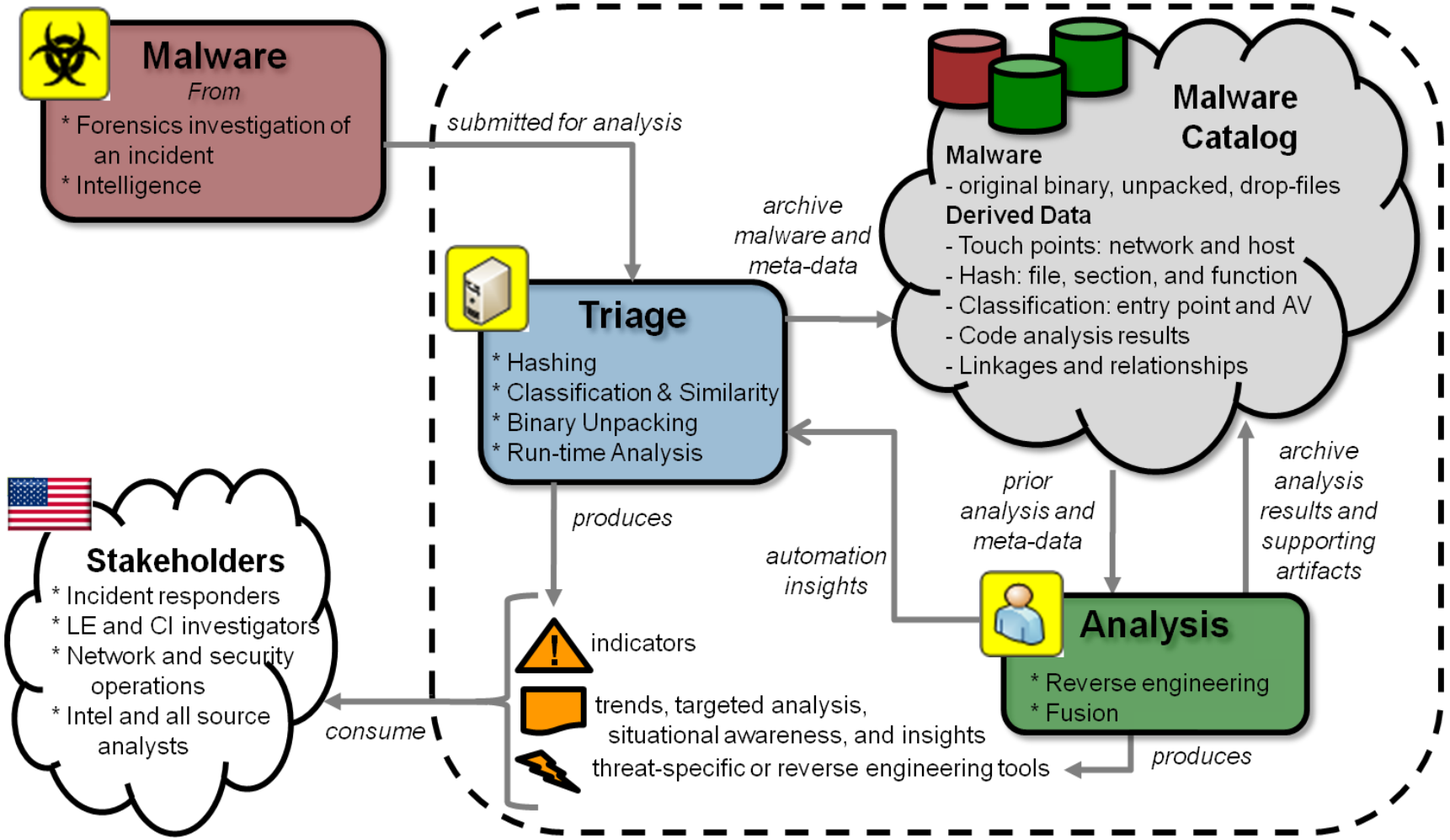
Network situational awareness

Software vulnerability analysis

Malicious Code

Mission	Focus Area
Develop new malicious code analysis insights, technologies, practices, and capabilities, to better counter and exploit adversarial use of information and communication technologies. • Defence Community • Intelligence Community • Federal Law Enforcement Community • Homeland Security / Federal Agencies • Federal Researchers	• Static analysis (reverse engineering) • Run-time analysis • Code comparison and characterization • Large-scale collection • Capacity building

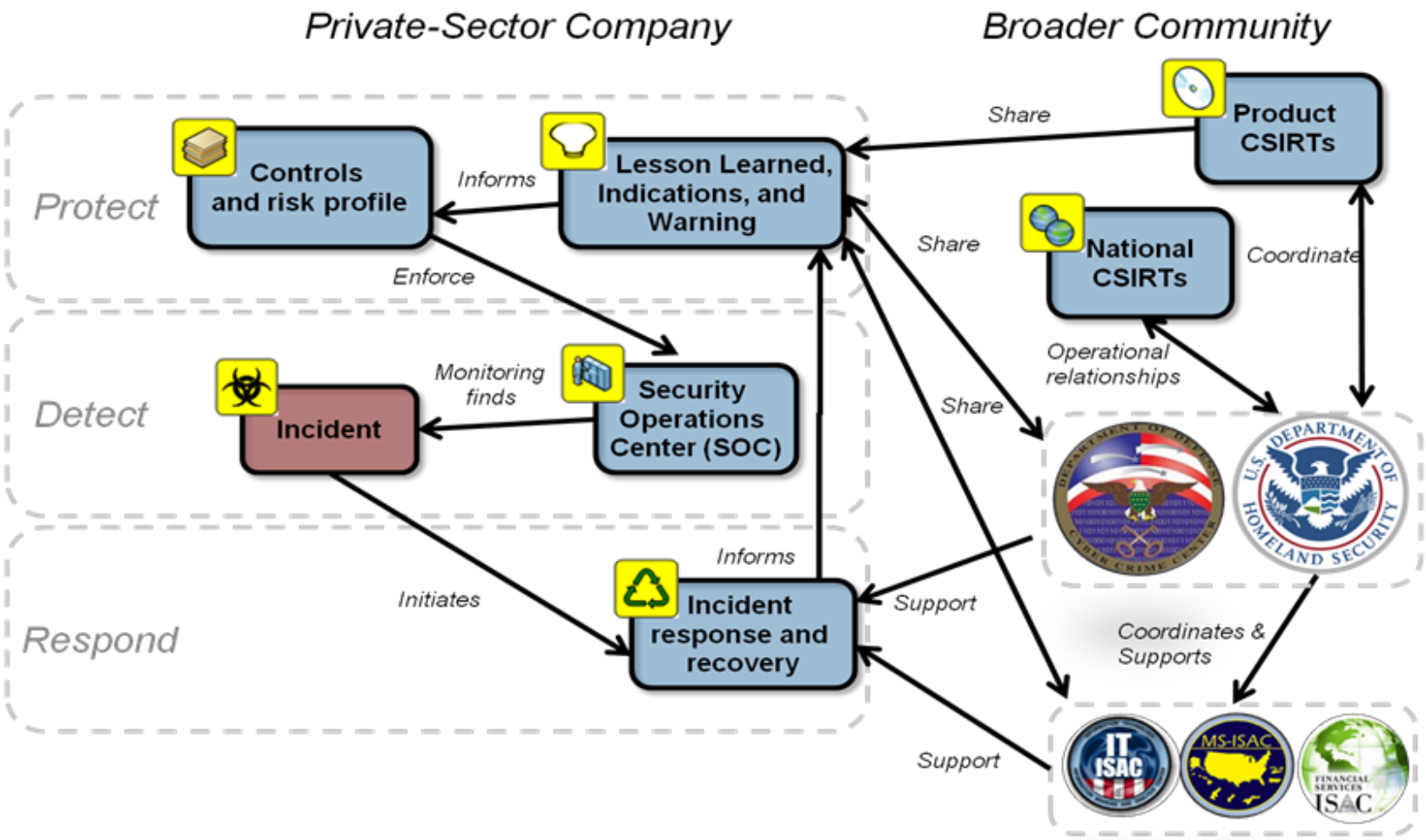
Malicious Code CONOP



Incident Analysis in the CIKR

Mission	Focus Area
Assisting USG and industry in combating advanced persistent threat • USG sector-specific leads • Information Sharing and Analysis Centers (ISACs) • CSIRTs with National Responsibility	• Incident analysis • Exercises • Capacity building

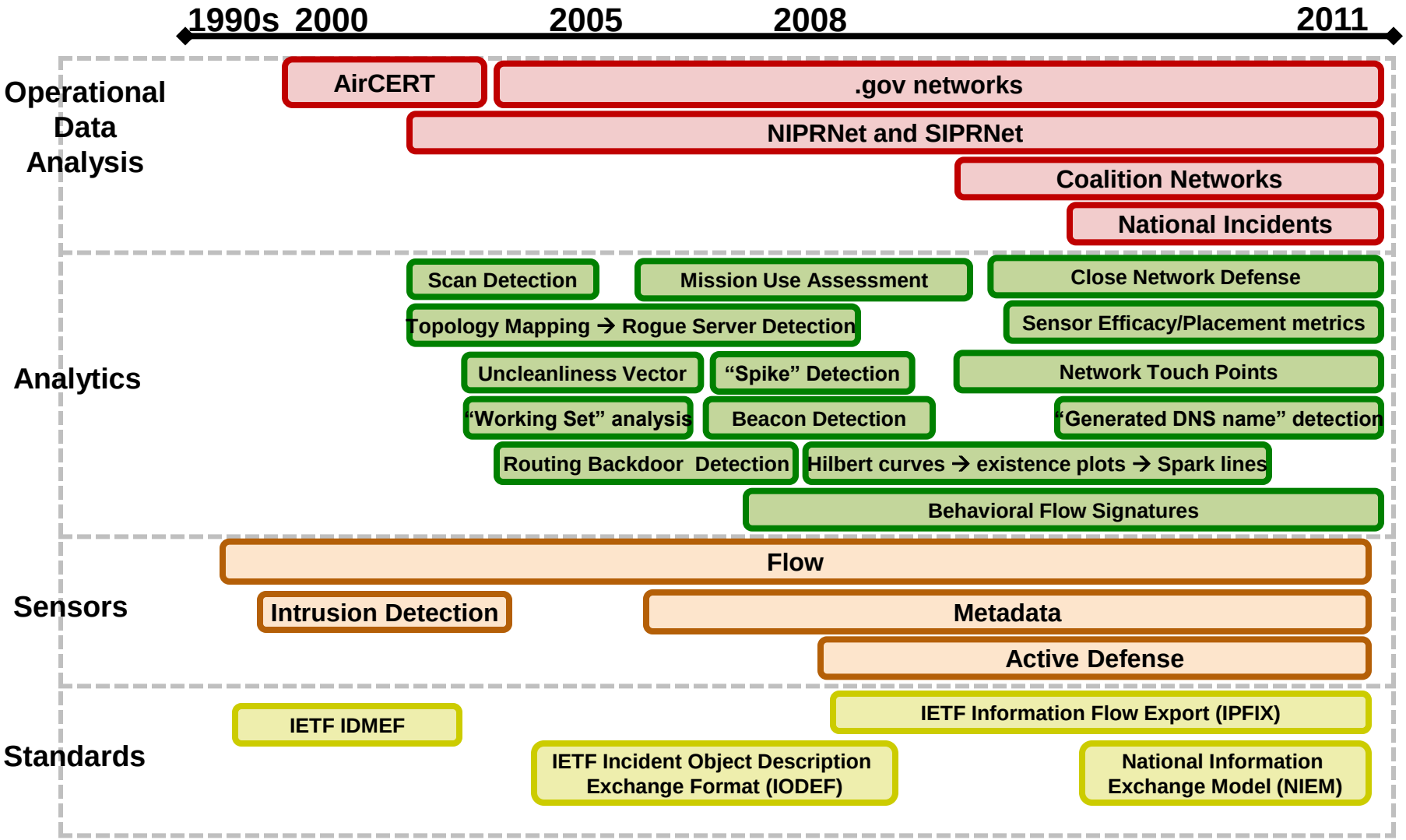
CIKR Collaborative Operations CONOP



Network Situational Awareness (NetSA)

Mission	Focus Area
Quantitatively measure baselines, vulnerability, threat, and intrusions to infrastructure from the network perspective • Pervasive USG CND monitoring efforts • Discovery missions • Survey missions • Enterprise policy makers and system architects	• Sensor development • Network analytics – Topology mapping – Traffic analysis – Situational awareness • Network test-beds • Standards • Metrics • Capacity building

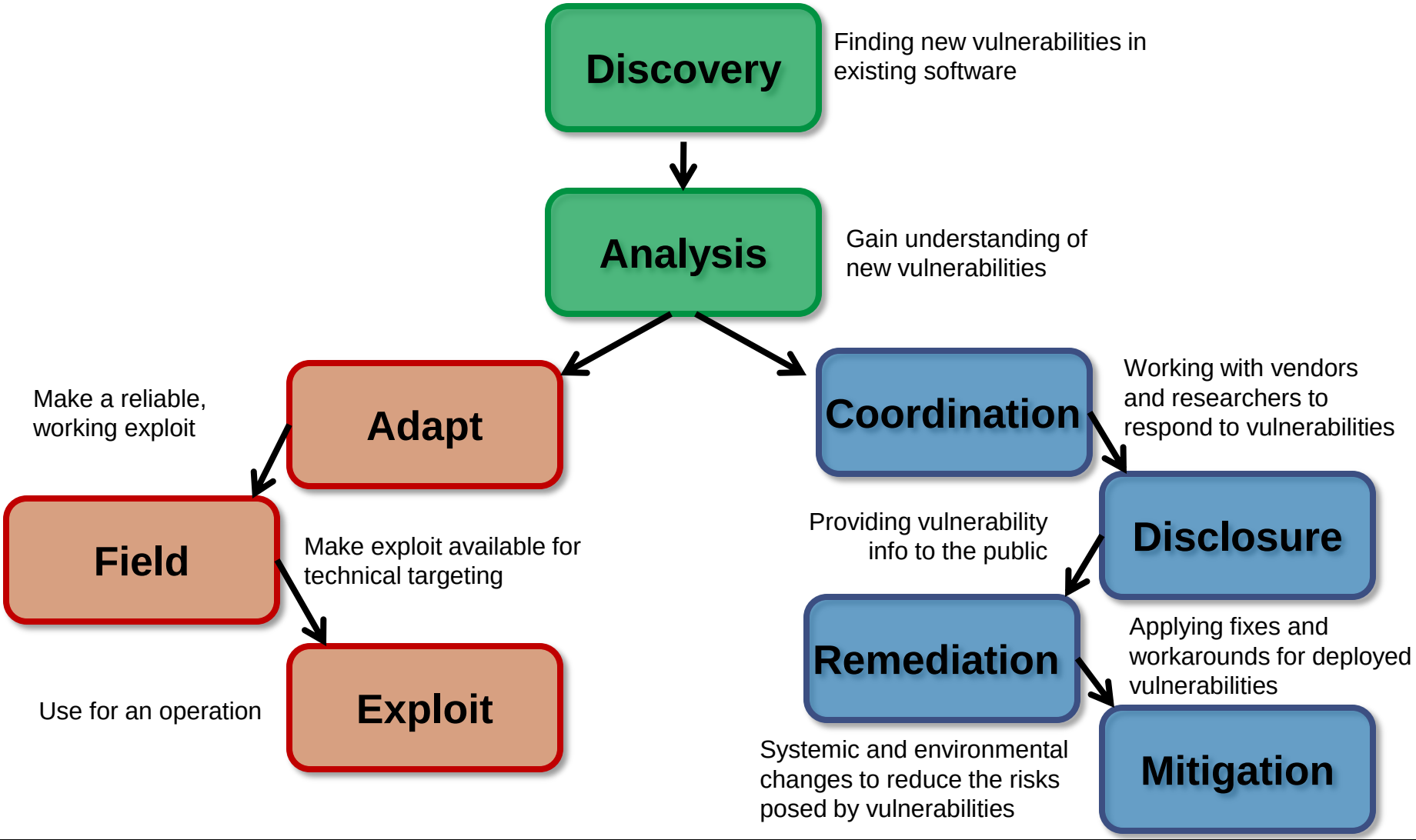
NetSA Historical Focus Areas



Vulnerability Analysis

Mission	Focus Area
Reducing the birth rate and increasing the death rate of software vulnerabilities; • USG watch-and-warning centers • CNA/E mission owners • Vulnerability researchers • Software vendors	• Vulnerability remediation • Secure configurations • Vulnerability management • Vulnerability discovery

Software Vulnerability CONOP



CERT Cyber Enterprise and Workforce Management Directorate

Software Engineering Institute | Carnegie Mellon

Cyber Enterprise and Workforce Management

Cyber

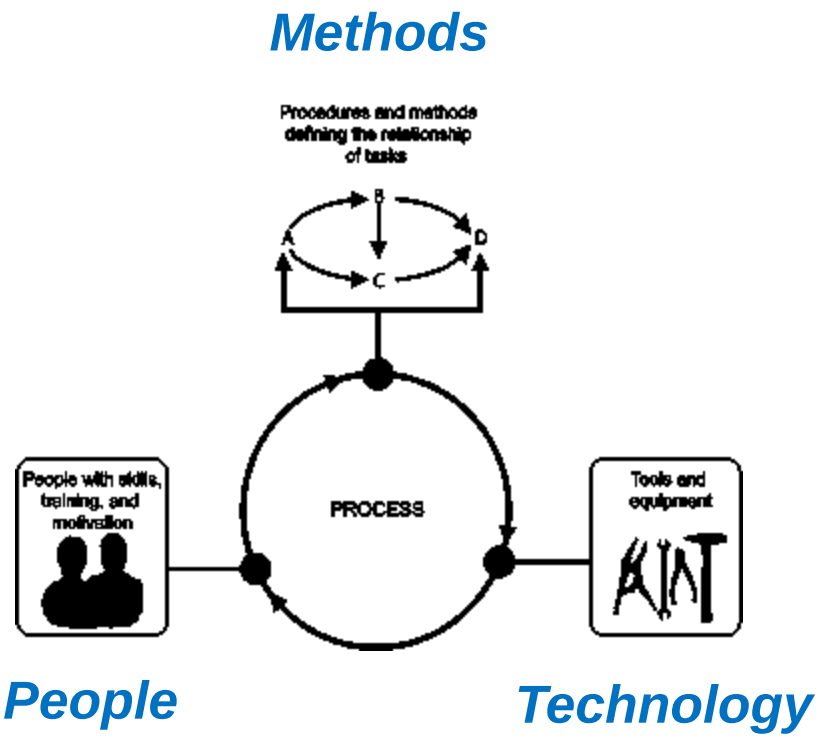
Describes the boundary of our work: assets that are bound together by networks

Enterprise and Workforce

Describes the entities on which our work is primarily focused

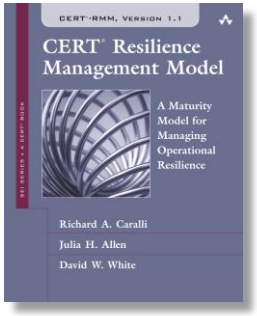
Management

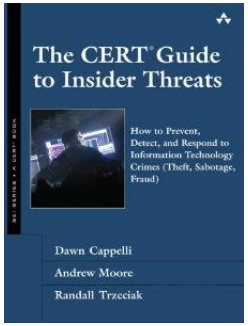
Describes the type of cyber security activities on which we *primarily* concentrate



CEWM's work engages all three critical dimensions for effectively managing cyber security.

CERT CEWM Overview





SGMM
Smart Grid Maturity Model

XNET

Cyber Resilience Center

- Cyber Security Risk Management
- Resilience Measurement
- Resilience Modeling & Simulation

Cyber Workforce Development (CWD)

- Workforce Development
- Cyber Exercise Modeling & Simulation

Enterprise Threat and Vulnerability Management (ETVM)

- Insider Threat
- Operational Threat Management

Infrastructure Resilience

- Critical Infrastructure Cyber Security
- Cyber Incident Management

What is CERT®-RMM?

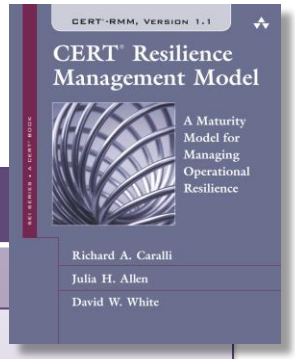
CERT-RMM is a maturity model for managing and improving operational resilience.

"…an extensive super-set of the things an organization could do to be more resilient."

- CERT-RMM adopter

- **Guides implementation and management of operational resilience activities**
- **Converges key operational risk management activities: security, BC/DR, and IT operations**
- **Defines maturity through capability levels *(like CMMI)***
- **Enables measurement**
- **Improves confidence in how an organization responds in times of operational stress**

CERT-RMM: 26 process areas



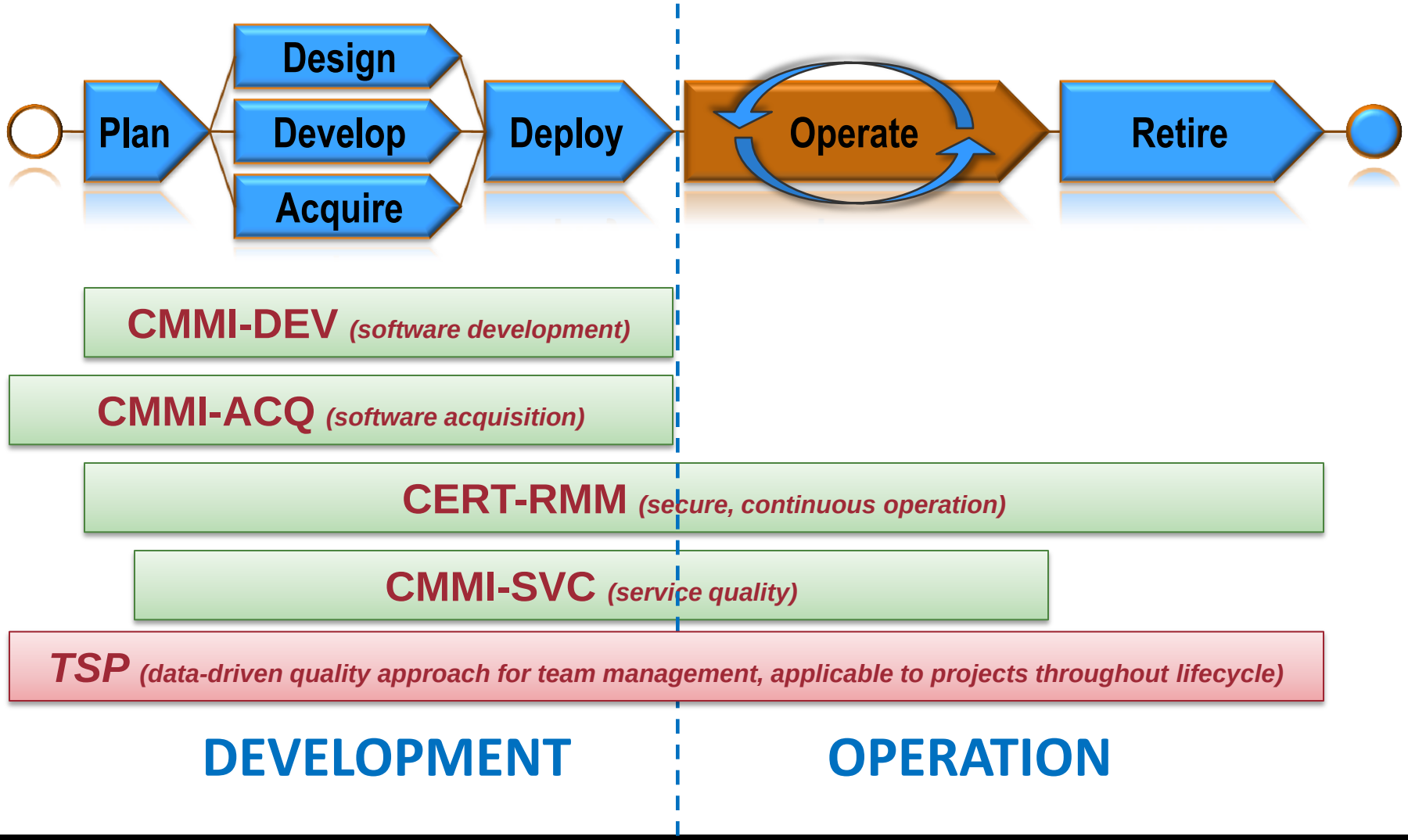
Engineering	
ADM	Asset Definition and Management
CTRL	Controls Management
RRD	Resilience Requirements Development
RRM	Resilience Requirements Management
RTSE	Resilient Technical Solution Engineering
SC	Service Continuity

Enterprise Management	
COMM	Communications
COMP	Compliance
EF	Enterprise Focus
FRM	Financial Resource Management
HRM	Human Resource Management
OTA	Organizational Training & Awareness
RISK	Risk Management

Operations Management	
AM	Access Management
EC	Environmental Control
EXD	External Dependencies Management
ID	Identity Management
IMC	Incident Management & Control
KIM	Knowledge & Information Management
PM	People Management
TM	Technology Management
VAR	Vulnerability Analysis & Resolution

Process Management	
MA	Measurement and Analysis
MON	Monitoring
OPD	Organizational Process Definition
OPF	Organizational Process Focus

Development and Operational Guidance End-to-End



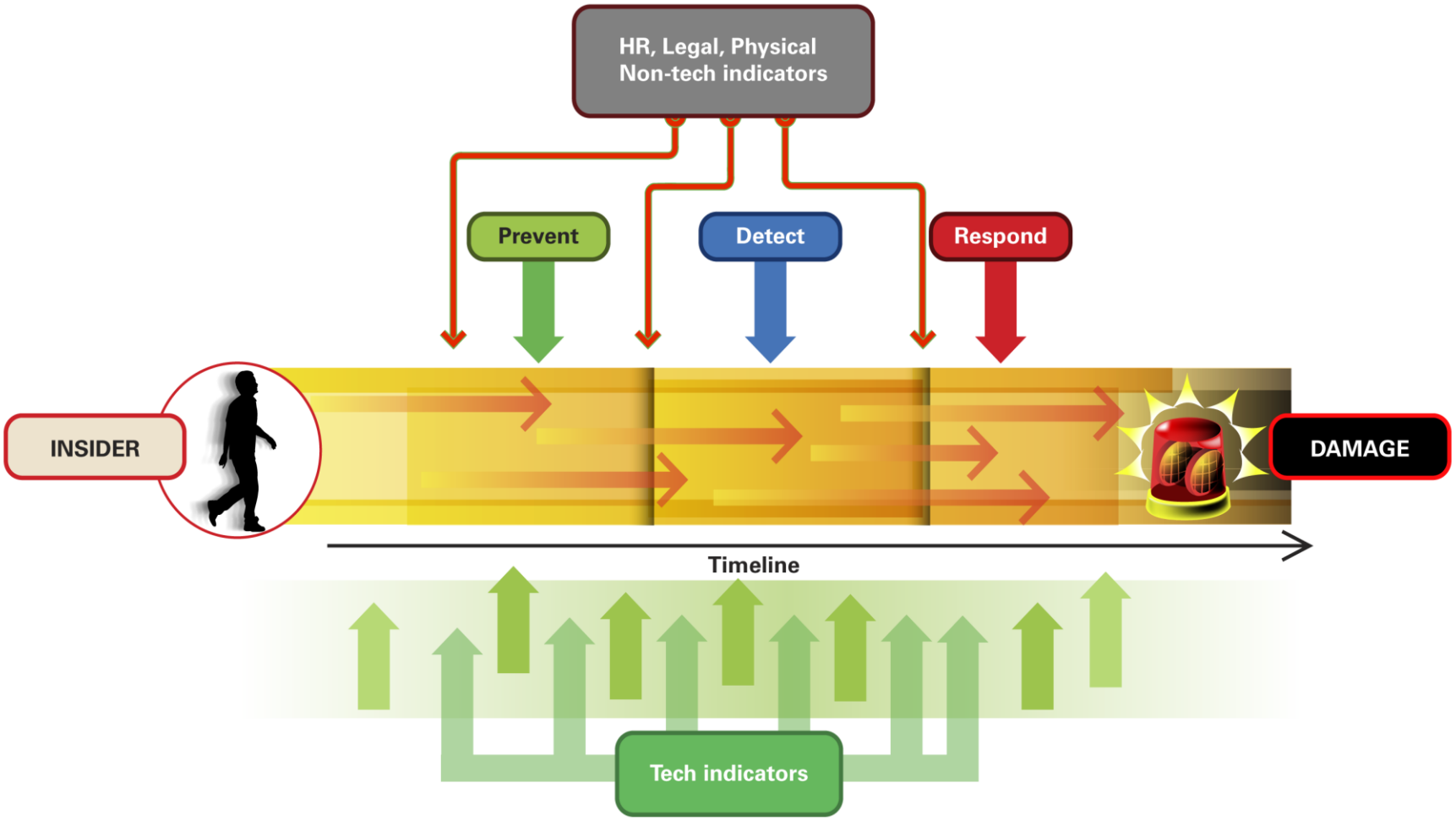
CERT Insider Threat Center

Center of insider threat expertise

Began working in this area in 2001 with the U.S. Secret Service

Our mission: *The CERT Insider Threat Center conducts empirical research and analysis to develop & transition socio-technical solutions to combat insider cyber threats.*

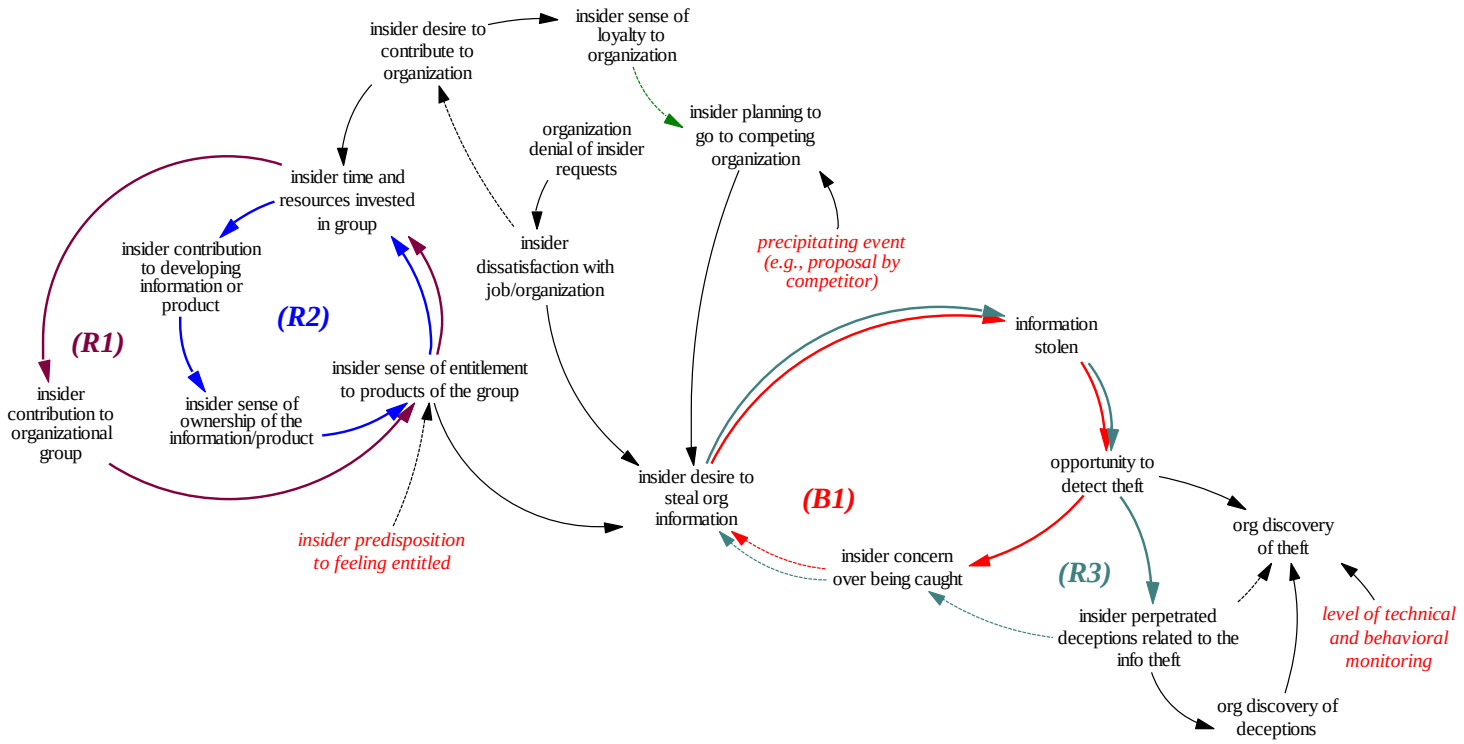
CERT Insider Threat Center Objective



Opportunities for prevention, detection, and response for an insider attack

Deriving Candidate Controls and Indicators -1

Insider threat research develops this…



Deriving Candidate Controls and Indicators -2

And turns it into this…

Splunk Query Name: Last 30 Days - Possible Theft of IP

Terms: 'host=HECTOR [search host="zeus.corp.merit.lab" Message="A user account was disabled. *" | eval Account_Name=mvindex(Account_Name, -1) | fields Account_Name | strcat Account_Name "@corp.merit.lab" sender_address | fields - Account_Name] total_bytes > 50000 AND recipient_address!="*corp.merit.lab" startdaysago=30 | fields client_ip, sender_address, recipient_address, message_subject, total_bytes'

DoD Cyber Workforce Development

Challenges

- Inability to “train as you fight” as part of routine operations
- Inability to accurately assess mission readiness of cyber units/crews
- Lack of real-time modeling and simulation tools for lifelike skills practice and assessment

SEI Response

- CWD Capabilities Definition and Measurement
- CERT Exercise Network (XNET)

CERT XNET

Goals of XNET:

- Convenient and Efficient Access to Range AND Scenarios
- Robust individual/team evaluation
- Advances in Mod/SIM
- Operationalize DoD Cyber Community

DoD Utilization:

- USCYBERCOM Cyber Flag exercises
- Army Reserve Information Operations Command pre-deployment evaluation
- OSD/NII International Cyber Defense Workshop (ICDW)
- Army Theater Cyber Center of the Year competition

Cyber Flag

USCYBERCOM sponsored, world-class cyber exercise

Exercise Service Components and JCCC in tactical cyber operations; progressive complexity over 4 mission days

12-1 Advances:

- Xcloud 1.0; 4,000 dynamically provisioned, controlled hosts/devices; 1-click roll-back, integrated record/playback
- Embedded Cyber Situational Awareness and COP 1.0
- “Whack a Mole” OPFOR
- 2,700 simulated users with under-the-floor, real-time control

13-1 Development:

- Automated helpdesk for “complaining users”
- COP 2.0; synergized feeds
- Kinetic CND (based-on Scadaville)
- Xcloud 2.0; instrumented for real-time lessons learned, BDA

Notices

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Cyber Mission Assurance (OSD CAPE)

Overview

Quick overview of “research vision” for the Cyber Mission Assurance work

Client example: Leveraging Cyber Mission Analysis Method(s) in support of OSD CAPE goals and objectives

Questions?

Cyber Mission Analysis Research Focus

Challenges

- Lack of understanding of network and mission impacts when capabilities are reduced
- Facing continually evolving adversary tactics, techniques and procedures (TTPs) to gather information and disrupt network/mission operations
- Very limited opportunities and resources to “train as you fight”

Research Approach & Innovations

- Leverage SoS architecture-centric methods with NSS’s cyber security initiatives to create a catalog of mission thread artifacts which can be used to analyze DoD networks for mission assurance and architectural agility and resilience
- Automation Framework to generate attacks which is integrated with XNET to perform cyber security workforce development and training based on the mission thread artifacts

Impact to DoD

- A streamlined and repeatable mission analysis method to improve mission assurance and situational awareness for cyber warriors and the missions being executed
- A single technique that enables the mission needs to drive architecture and training

Mission Assurance Research: Guiding Scenario

An adversary is interested in gaining footholds into DoD networks via its computer network exploitation methods

Two key points of interest have been identified

Naval Personnel Information at Port Hueneme

Naval Maintenance Operations – San Diego

Guiding Scenario – Current Approach

1 Adversary performs "phishing" attacks and compromises 3 workstations in each network and a privileged account on the Personnel system

US imposes tariffs and sanctions on adversary country; Intelligence reports note adversary is considering taking some action

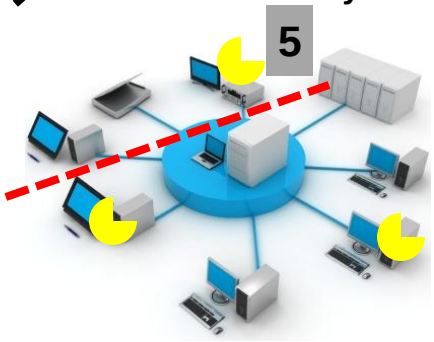
2 Adversary starts Denial of Service Attacks on Operations system

5 Adversary begins exfiltration of personnel information

6 Adversary stops attack after personnel information is downloaded

7 Adversary stops DOS attacks

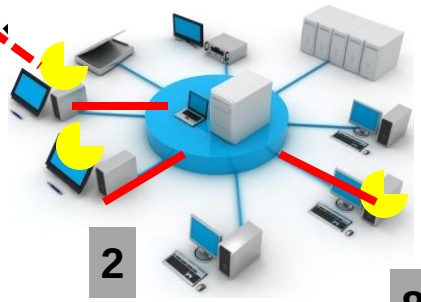
Personnel System



9 Network admins notice data has been exfiltrated two days after incident; Investigation is started

Adversary's System

Operations System



3 Users start to complain about slow operation of their system

4 Network administrators execute their TTPs and identify DOS attacks

8 Network admins notice DOS attack has stopped and begin network battle damage assessment

Guiding Scenario – Desired End State

1 Navy locations identify key missions and cyber dependencies to drive training using the latest automated technologies

2 Adversary performs "phishing" attacks and compromised 3 workstations in each network and a privileged account on personnel system

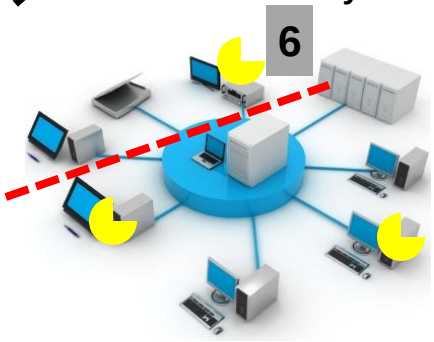
3 Adversary starts Denial of Service Attacks on Operations system.

6 Adversary begins exfiltration of personnel information. Network admins confirm threat pattern and mission impact

7 Network admins stop attack shortly after download i attempted

8 Adversary stops DOS attacks

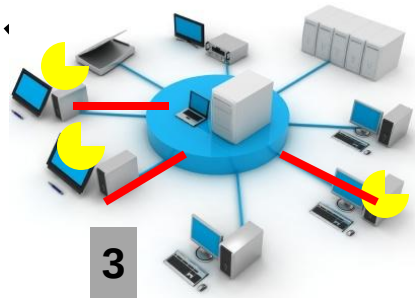
Personnel System



10 Network admins assess variations in attack patterns and mission areas being targeted to update and conduct training

Adversary's System

Operations System



4 Users notice slow operation but critical functions continue

5 Network admins detect a possible threat pattern

9 Network admins quickly determine damage is minimal

Properties of Desired End State

Clear Mapping to Cyber S&T Priorities*

- **Increasing Adversary / Defender relative work:** The cyber attack is stopped with fewer resources on the part of the defender
- **Assuring Effective Missions:** The critical missions were identified and related to cyber vulnerability and attack patterns to enable rapid detection and reaction to the attack.
- **Resilient Infrastructure:** The critical system functions were identified and mapped to architectural dependencies to build-in mission assurance

Assertions to Achieve Cyber S&T Priorities

- Long term automation objective requires understanding the analytical framework, technical dependencies and patterns of cyber operations
- Enabling rapid, repeatable and flexible training is critical both in the near term and to utilize eventual automation techniques

Cyber S&T Priority Steering Council Research Roadmap, NDIA Disruptive Technologies Conference, 8 Nov 2011

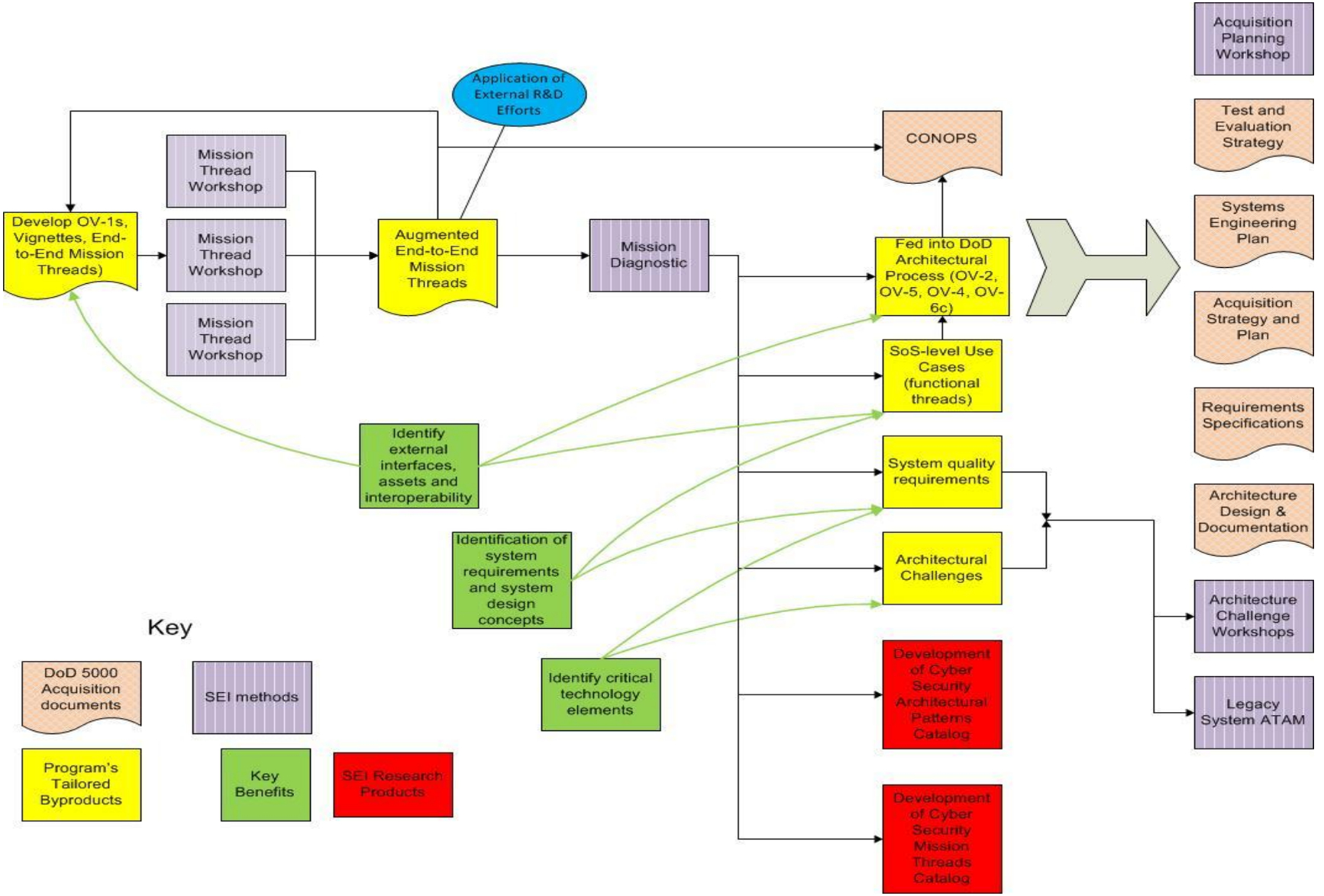
Task A1: Create a catalog of cyber security mission thread artifacts

Problem 1

Can an approach be developed to enable our cyber warriors to quickly gain an understanding of operational impacts on their networks and missions when cyber actions are considered in response to attacks/threats?

- Need an approach which can be used to analyze and evaluate the agility and resilience of the infrastructure
- The approach must support mission assurance analysis
- The approach needs to be able to address changing adversary TTPs
- Risk identification and prioritization is a key aspect that must be addressed

Task A1: High-Level Cyber Security Mission Thread Approach

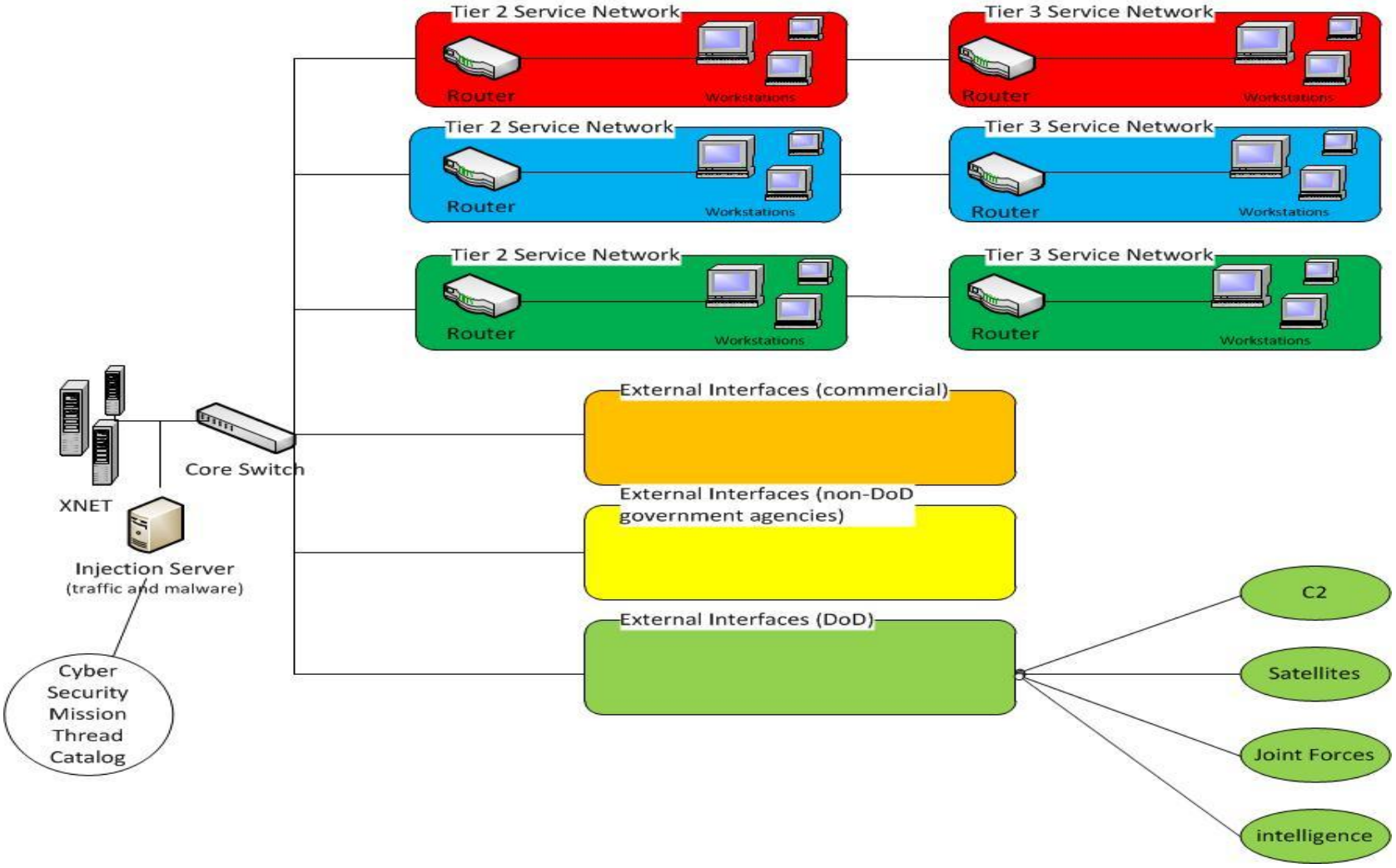


Task A2: Develop Cyber Security Workforce Development Framework

Solution

1. Work with the XNET team to incorporate the use of the mission thread artifacts to create a catalog of scenarios
2. Work with the Malicious Code team to define requirements and develop a malware-like framework which supports XNET and the scenarios being developed
3. Based on previous XNET cyber exercises, evaluate traffic/data generation capabilities and the need to enhance the XNET capabilities to support the scenarios being developed
   - internal application, MIT's Lariat or other external applications
   - external interfaces to real/simulated hardware/communication links
4. Pilot with organizations with existing XNET setups

Task A2: Cyber Security Workforce Development Training Approach



Supporting client need: OSD CAPE

Mission

OSD CAPE responsibilities include:

- analyzing and evaluating plans, programs, and budgets in relation to defense objectives and threats
- providing leadership in developing improved analytical tools for analyzing national security planning
- ensuring that the costs of DoD programs are presented accurately and completely

Adapted from http://www.cape.osd.mil

SEI Objective

Enable DOD to develop a Cyber Front End Assessment Model and Approach that:

- prioritizes OSD C4 mission objectives
- develops executable mission threads in order to create high impact and realistic scenarios that drive unit, component and joint virtual training exercises (and modeling and simulation)
- results in data collection and metrics that can be leveraged to make meaningful IT/Cyber programmatic decisions

Challenges with current approach

- Treating each exercise as a “one-off” event is inefficient and doesn’t support consistent measures for analysis across events
- Lack of clarity around defined resiliency measures
- Need for objective ways to measure and analyze exercise results

OSD CAPE: Approach

Leverage multiple SEI methods:

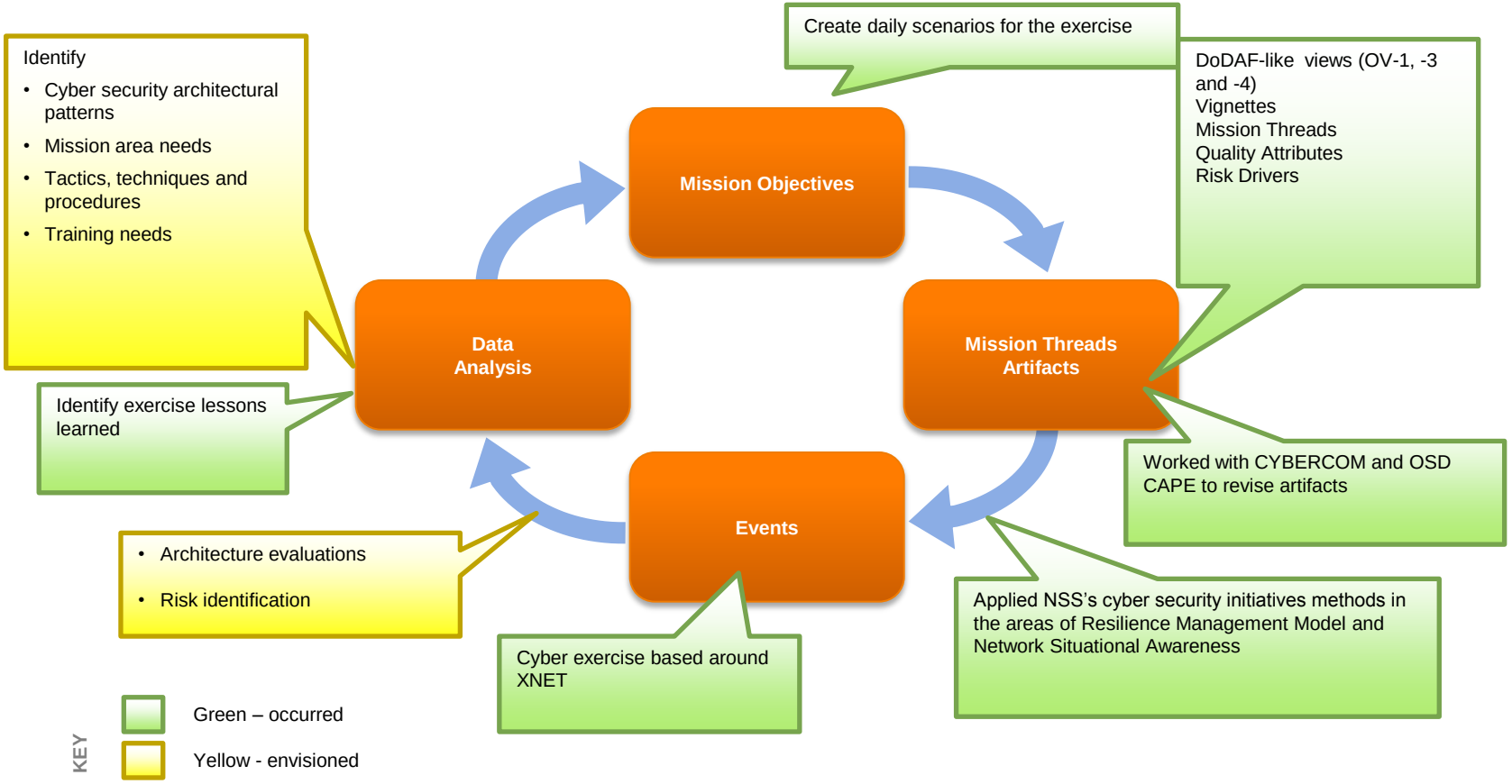
- Apply RTSS Architecture-Centric Mission Thread method to prepare for upcoming cyber exercise scenarios
- Work with CERT Network Situational group to bring into consideration real-life issues they are addressing supporting DoD networks
- Apply CERT Resilience Management Model as the framework to define resiliency measures

Work with CERT Malicious Code group to get an understanding of how an attack (like phishing or a PDF-exploit) works and incorporate that into the mission thread

Participate in exercises to analyze effectiveness of cyber mission threads and collect resiliency measurement data for post-event analytics

Revise baseline mission threads and measures that can be leveraged for next exercise

OSD CAPE: End-to-End Lifecycle



OSD CAPE

Impact

- SEI preliminary mission threads were used during the cyber exercise pre-planning meeting, led by LCDR Michael C. Holland USCYBERCOM J-73, to develop scenarios for the December Cyber Flag exercise
- Information provided by the SEI, and others, is being used at the initial planning conference for this year's cyber exercise mission to help prepare for the next exercise.
  - For example, mission threads providing additional detail about threats origination are likely to be used to decide where to put sensors for the next exercise.

Impact Statement Dr. Dixon, OSD CAPE (paraphrased):
"Cyber Flag daily scenarios were significantly enhanced due to the mission thread method."

Recent OSD CAPE Activity (2/28/12)

Completed delivery of data analysis efforts from Cyber Flag 12-1

- Identified what information was able to be recorded during the exercise (through sensors), as well as what information was not able to be captured due to sensor placement, storage, etc.
- Identified what additional information could be obtained in future cyber exercises based on:
  - Earlier and more detailed pre-planning for the cyber exercise
  - If additional resources were applied to existing setup
- Provided proposal to OSD CAPE client for how to apply the end-to-end cyber mission assurance approach (circle flowchart graphic)

Other potential and current clients applying approach

- Currently leveraging secure mission thread approach on DHS S&T Commercial Warning Automated System (CMAS) project
  - Mission threads used to define emergency response scenario analysis and to identify security threat risks
- OPNAV N-81 interested cyber defense and modeling
- Multiple related discussions across DoD and Intel community
- Developing research proposal targeted at establishing a Mission Assurance program initiative

OSD CAPE Next Steps

Data Planning/management/processing for a cyber exercise

- Requested SEI's continued support for Cyber Flag 13-1 planning and exercise data observer
  - Provide a new work plan which reflects guidance and options provided
- Continue to focus on improving the ability to record and analyze data
  - Based on vignettes/scenarios being proposed to CYBERCOM for Cyber Flag 13-1:
    - Identify how best to take advantage of existing equipment
    - Identify possible additional data collection capabilities and associated costs
  - Consider providing remote data analysis capabilities for the exercise

Data processing/analysis for cyber mission assurance

- Augment the vignettes/scenarios based on mission assurance approach to identify possible options within the scenarios and the ability to record the information to confirm the events which occurred
- Work on developing the vignettes/scenarios to better reflect current operational situations
- The augmented vignettes/scenarios will be offered by OSD CAPE to CYBERCOM for consideration in Cyber Flag 13-1

How is this related to today's Challenges?

"We have an independent strategic assessment group made up of senior experts from a whole variety of disciplines across military and civilian organizations …So the reco**Mission Thread Analysis**ly took on and I think I'm ex**Mission Diagnostics** of these…We've got to analyze what are the things that are most important to us, prioritize them and decide how do we defend them **Cyber Mission Thread Catalog** machine-to-machine situational awareness relationships, both in and out of the defense focused networks. Create and incorporate automated indications and warning **Automation Framework** are. They know when an attack might be occurring and can warn us ahead of time instead of telling us that something has occurred. **Cyber Threat Patterns** aracterize better. Look for the cause, the risk and the mitigation of an event.

Interesting comment out of this [assessment] group that people need to be reminded that the networks aren't the mission, the networks support the mission, and I think there was a period of time where we maybe kind of strayed a little bit and looked at cyber as its own art form and it was the mission and, in fact, like space it enab**Systems of Systems Approach** ur and if we're not looking at it from that broad enterprise aspect we will probably not be successful."

10.20.09 - REMARKS BY GENERAL GENE RENUART at the AFCEA Defending America, Cyber 2010

Questions?

Virtual Training Environment (VTE) and XNET Overview

NETCOM - VTE & XNET

Overview of VTE

Overview of XNET

Integrating VTE & XNET into NETCOM Training

VTE (http://vte.cert.org)

Asynchronous Knowledge and Skill building

- Captured Classroom Lectures
  - Slides, Video, Transcript, Learning Management System
  - Enterprise management tools
- Instructor Demonstrations
  - Narrated Screen-recordings that teach specific skills
- Hands-on Labs
  - Practice for developing cybersecurity skills

VTE (http://vte.cert.org)

Entry Level Training

- Security +
- IAT Level I
- IAM Level I

Advanced Level Training

- CISSP
- CISA
- ISSEP

Technology Specific Training

- IPv6
- Wireless Security
- SiLK & Netflow Analysis

The Cyber Exercise Challenge

How to make cyber exercises routine, realistic, repeatable, and cost effective?

- Logistics
  - Travel and facility cost
  - Building/managing exercise infrastructure
- Complexity
  - Difficult to create realistic and current scenarios
  - Exercise infrastructures too monolithic
- Outcome
  - Limited benefit to workforce cyber readiness

Solution: CERT Exercise Network (XNET)

Browser-based access to mission-specific cyber-exercise environment

Frees units from the resource intensive tasks of…

- building
- deploying
- administering

…the exercise environment

Allows controllers to focus on exercise objectives

XNET Overview

Web-based Access

Centrally managed Infrastructure

Customizable Scenarios

Structured Control

Team Collaboration

Assessment and Observations

Access

Requires

- Web Browser, Java, and Internet connectivity

Self-contained environment

- Scenario network traffic contained in virtual sandbox via RDP Air-Gap

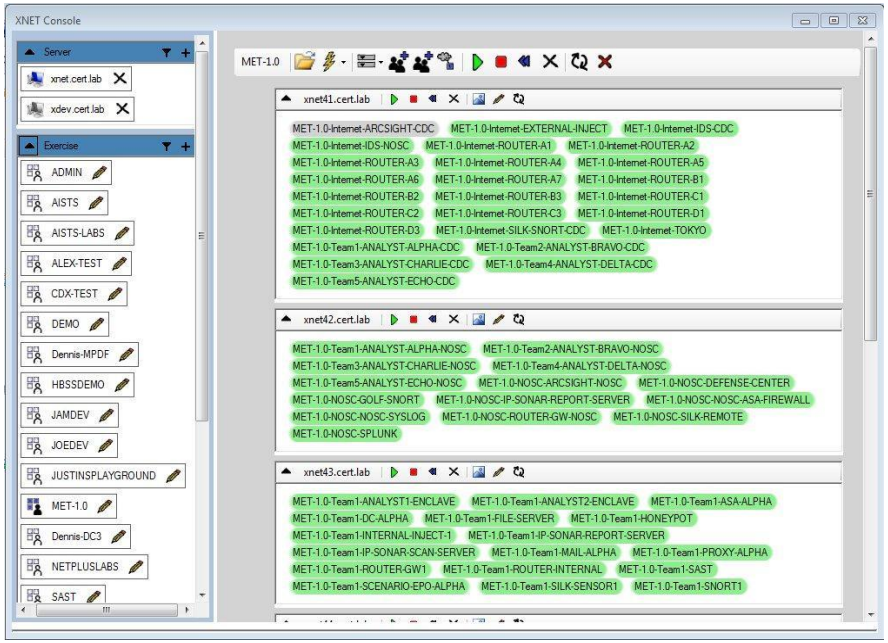
Geographically Separated Teams have Instant Access to Live Exercise Scenarios

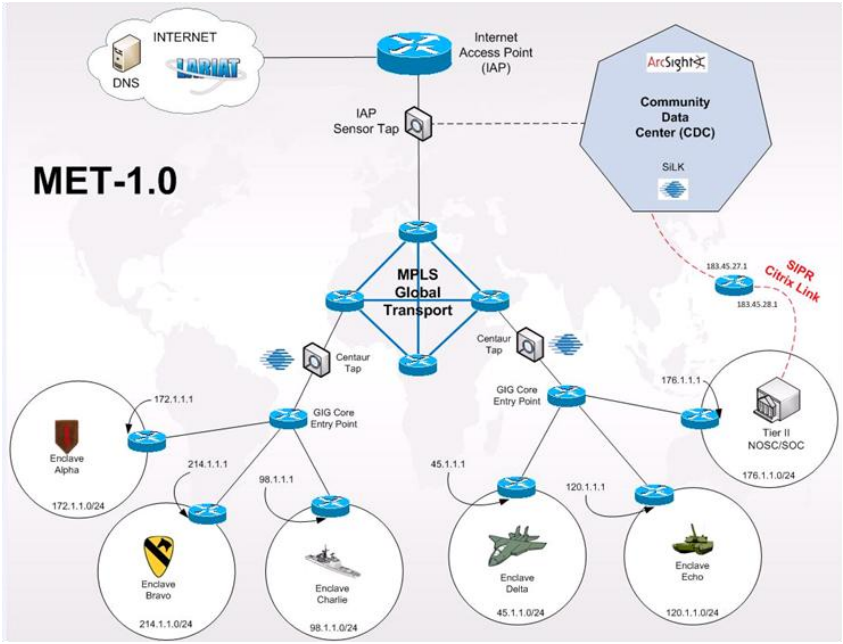
Centrally Managed Infrastructure

NextGen Virtualization

Granular Exercise control

Can “Plug-In” to DoD Ranges

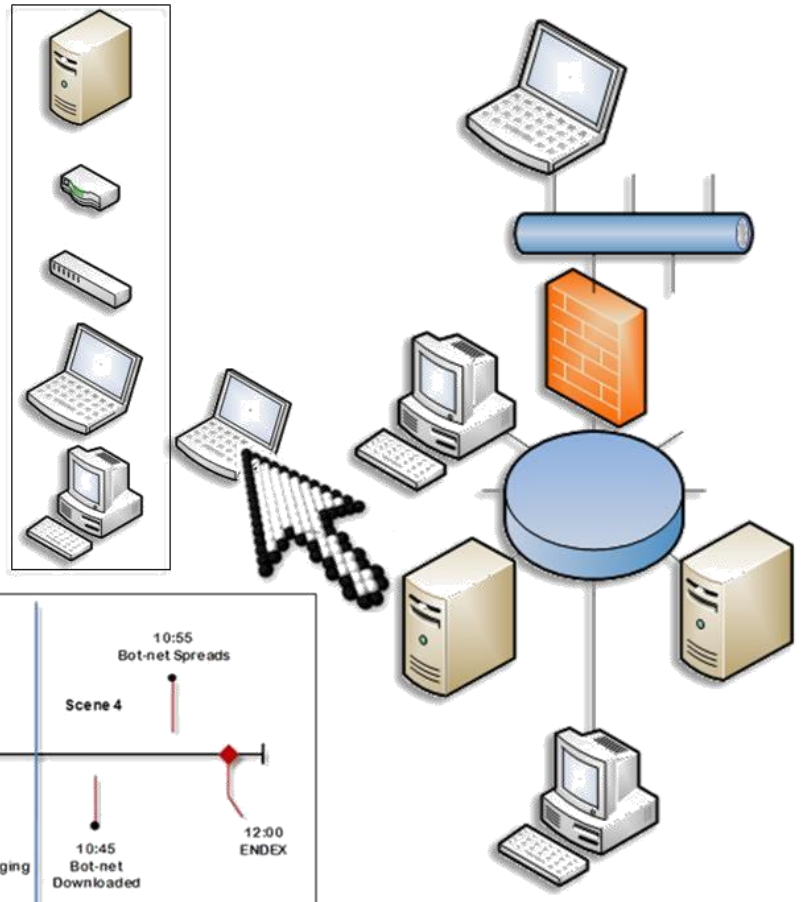


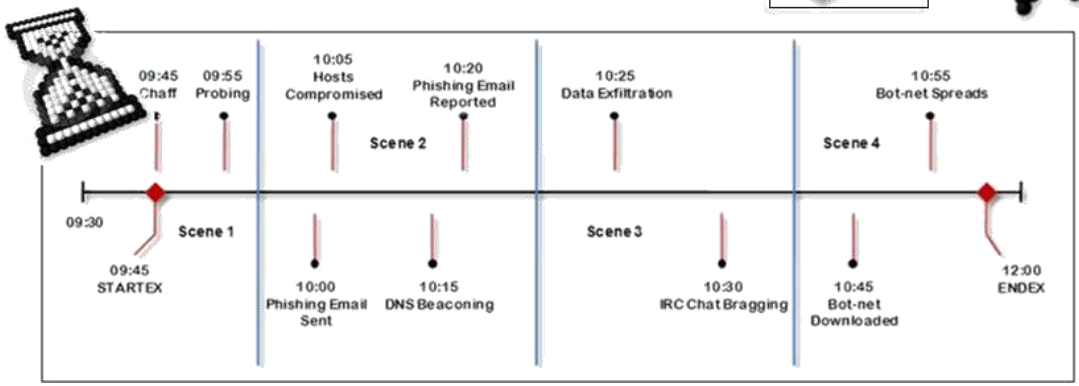


Customizable Scenarios

XNET allows you to:

- Create your environment
- Create your events
- Create your timeline

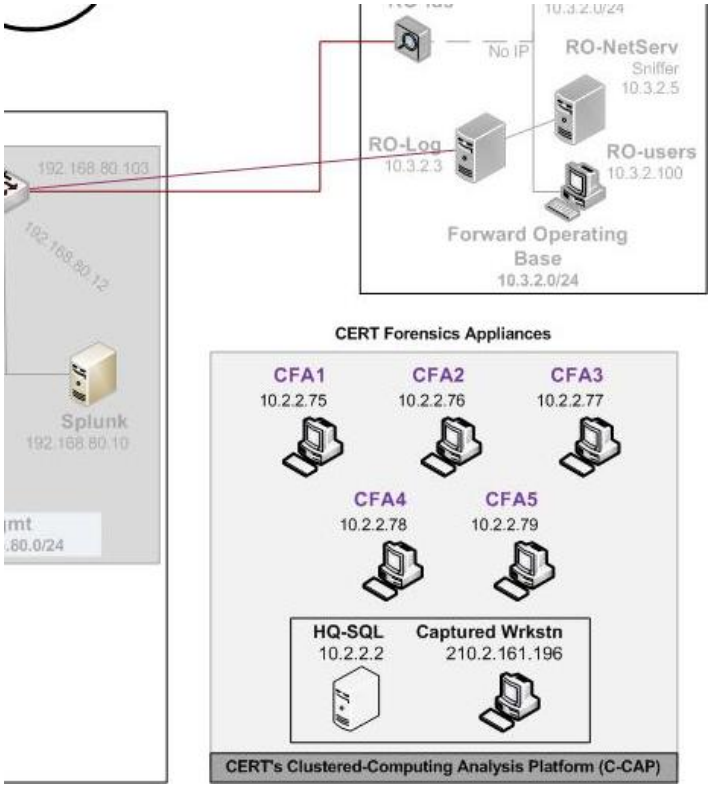




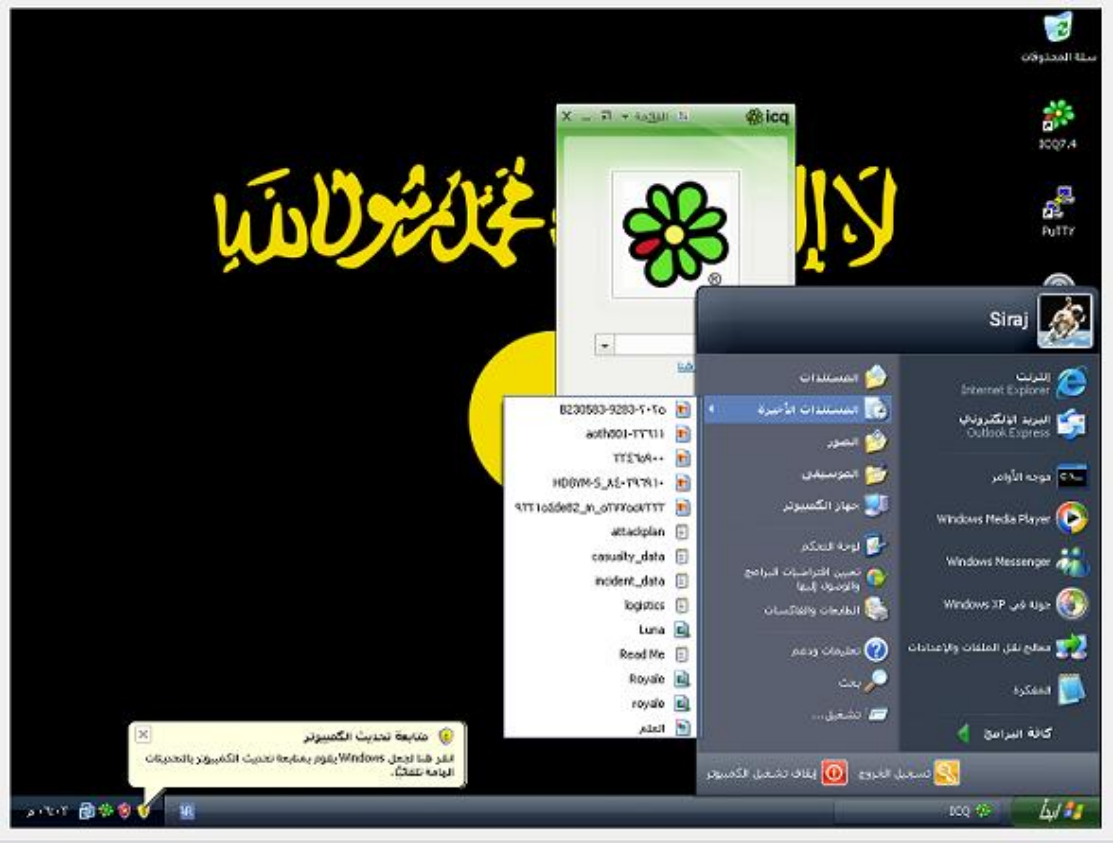
Customizable Scenarios – Forensics

XNET utilized to provide a real-time Forensics Challenge for Annual Cyber Defense Exercise

Access to CERT Forensics Appliance, LiveView Images, C-CAP



Notional Captured Workstation – Native Arabic XP Install



Structured Control

On-the-Fly modification

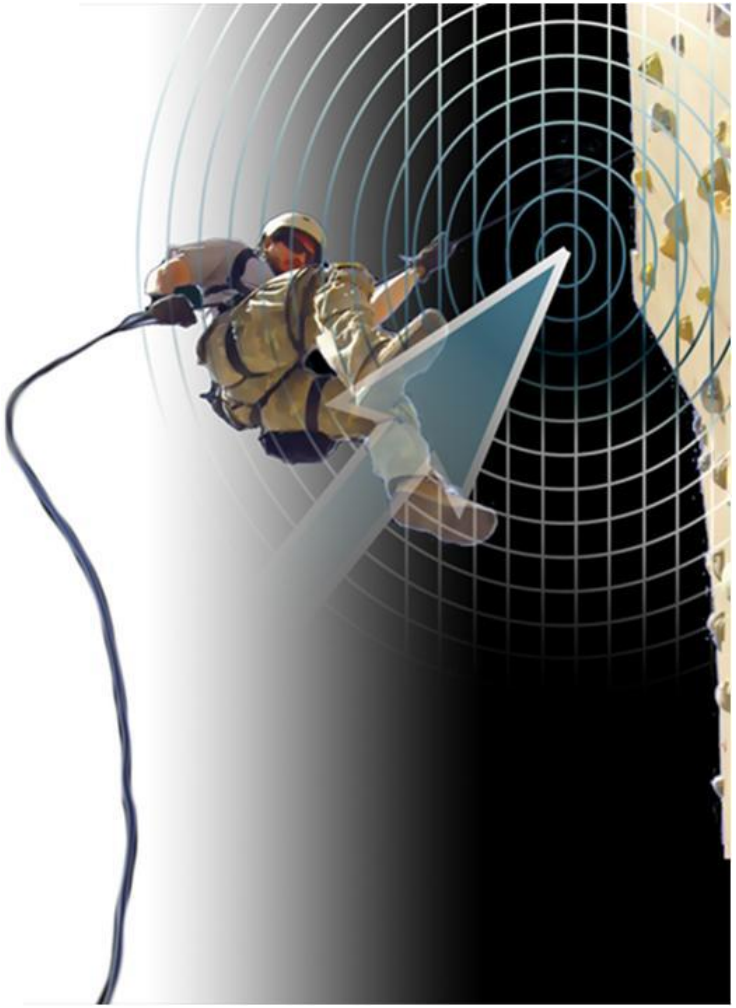
- Timeline and Event Library

Realistic Threats

- Drag and Drop attacks/anomalies
- Robust traffic generation

Automated data collection

- Real-time readiness metrics



Team Collaboration

Chat

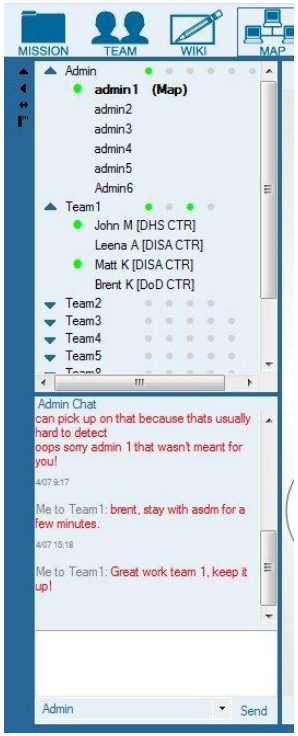
- Instant out-of-band communications

White boards via WIKI pages

- Collaborate on problems, share ideas, answer team questionnaires

Scenario Maps

- Share remote desktop (learn from others)
- Work as a team in a single environment



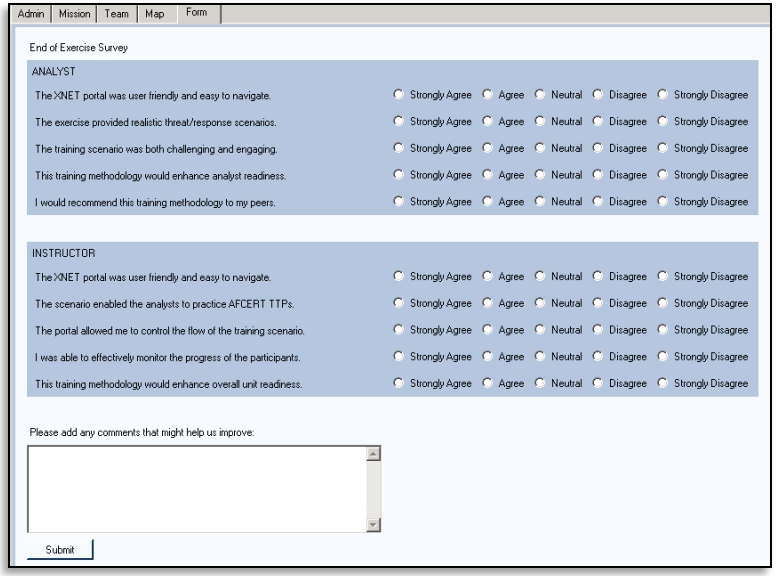
Assessment and Observation

Allows users to:

- Provide Feedback
- Take Quizzes
- Submit Reports

Allows evaluator to:

- Glean Instant feedback
- Pose Leading Questions
- Evaluate users responses
- Access Automated Scoreboard



XNET: Force Utilization Examples

US Army NETCOM

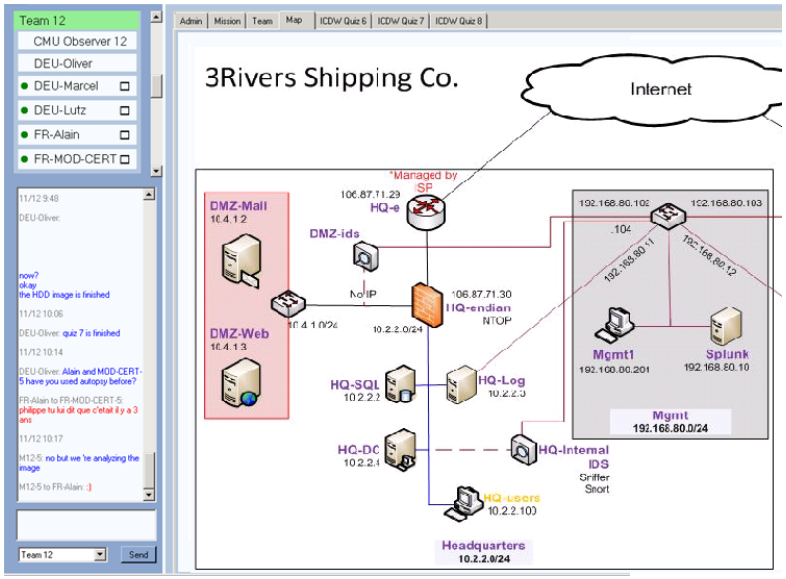
USAF

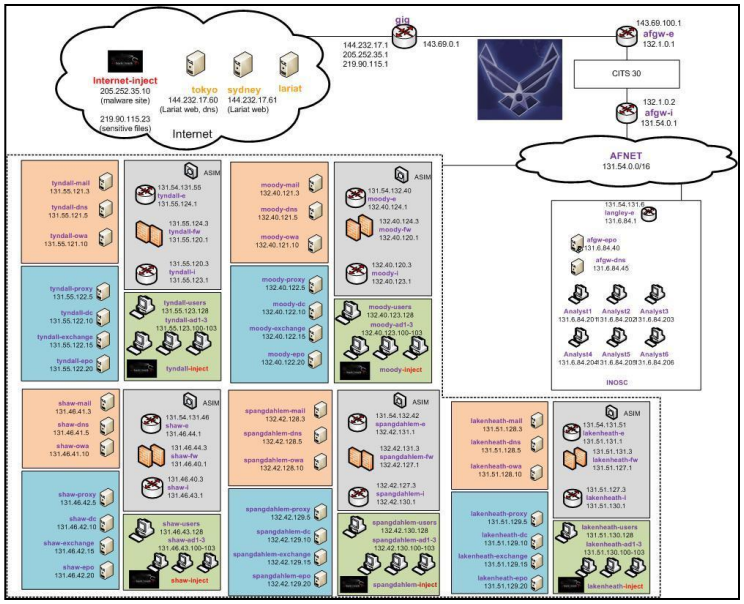
US Army Reserves

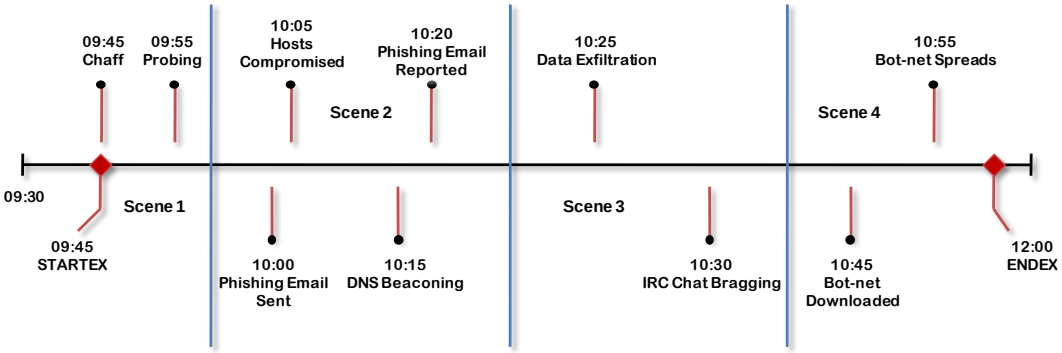
OSD/NII

NSA

DHS / US-CERT



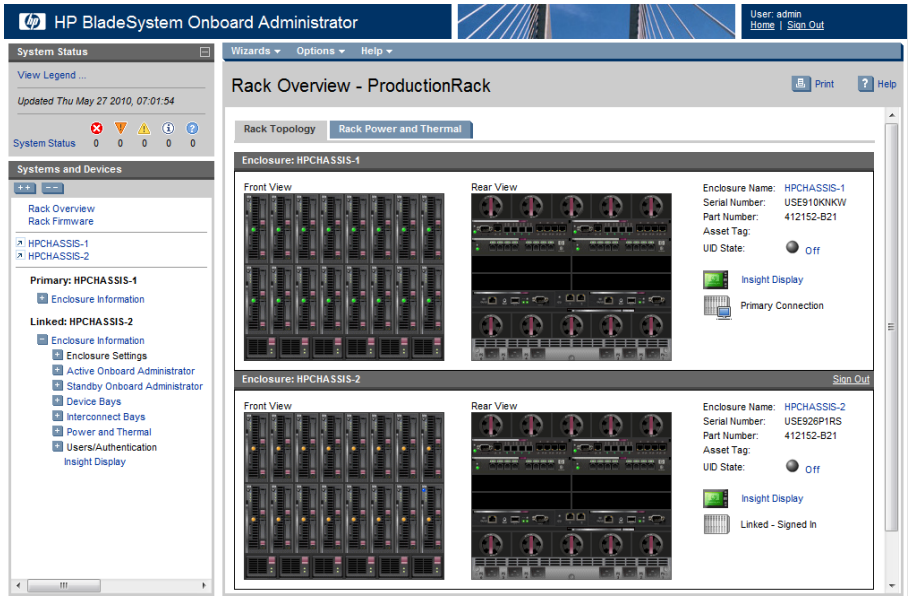




Infrastructure

Fixed (Primary)

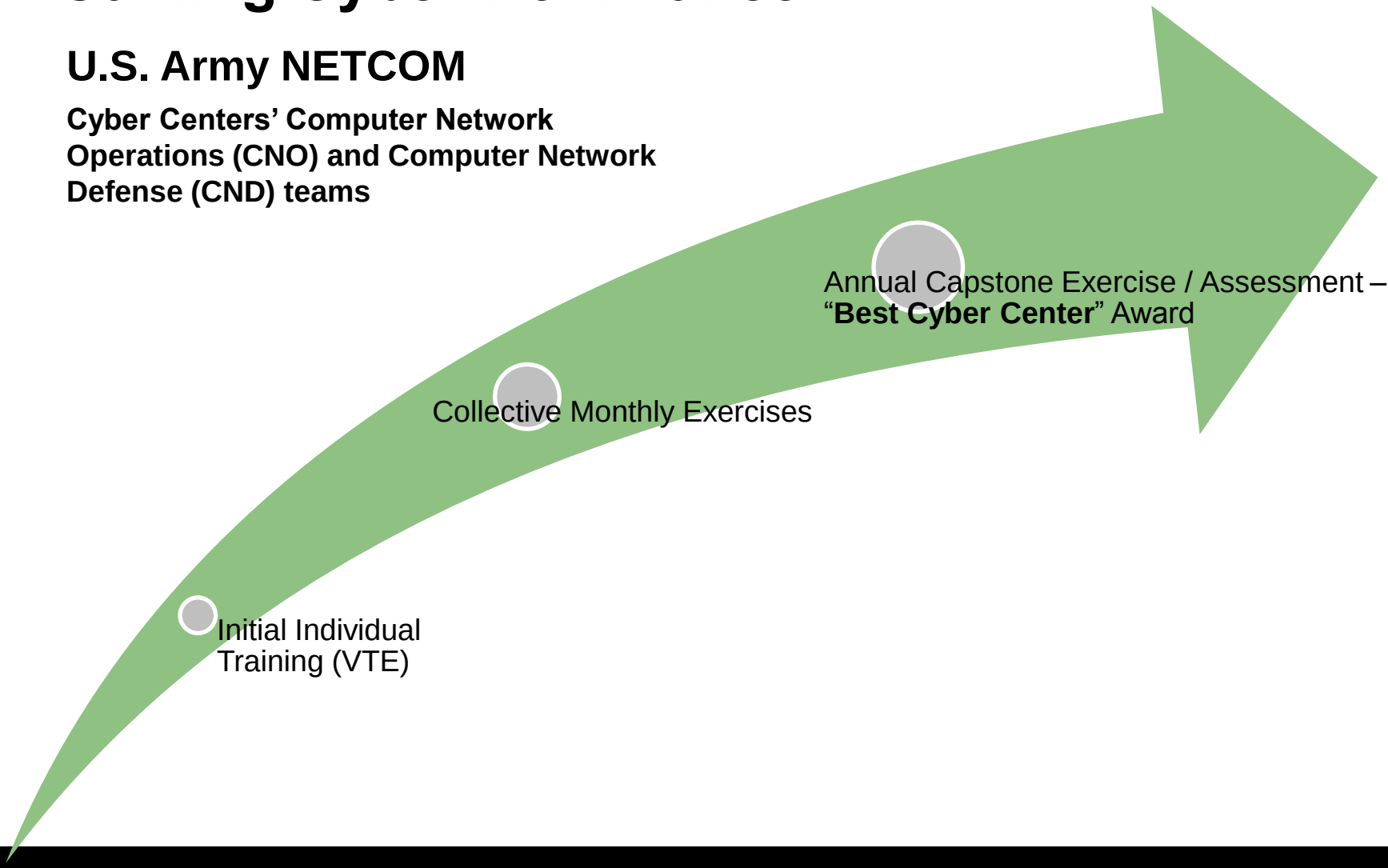
Deployed
(secondary alternative
- limited capabilities)



OPERATION ELITE MERCURY
"Gaining Cyber Dominance"

U.S. Army NETCOM

Cyber Centers' Computer Network Operations (CNO) and Computer Network Defense (CND) teams



XNET Scenario Introduction

Brent Kennedy

27 March 2012

Example Scenario Overview

Our scenario today was utilized during mission validation of the U.S. Army Reserve Information Operations Command's Detachment 52 in its preparations for mobilization and deployment to Cyber Center SWA.

Your mission is to gain full situational awareness of the network including normal and abnormal traffic.

The exercise is divided into 2 overall sections.

The first section will be network reconnaissance which includes familiarization with the systems and tools, benchmarking the network traffic, and testing all hosts for vulnerabilities.

The second section will introduce active attacks. As a collective group, you must identify the attacks to determine what they are doing and where they are coming from.

Scenario Overview (continued)

The network you must protect is divided into 3 parts: NOSC, Fort Hood, and Fort Huachuca.

The NOSC is "physically" located at Fort Hood but can be thought of as a separate network.

During your network reconnaissance take a close look at each network.

You should have a full understanding of all the hosts they contain as well of the traffic coming in, out, and within.

Scenario Overview (continued)

Topology overview

External scanning

Zones: NOSC, Hood, Huachuca

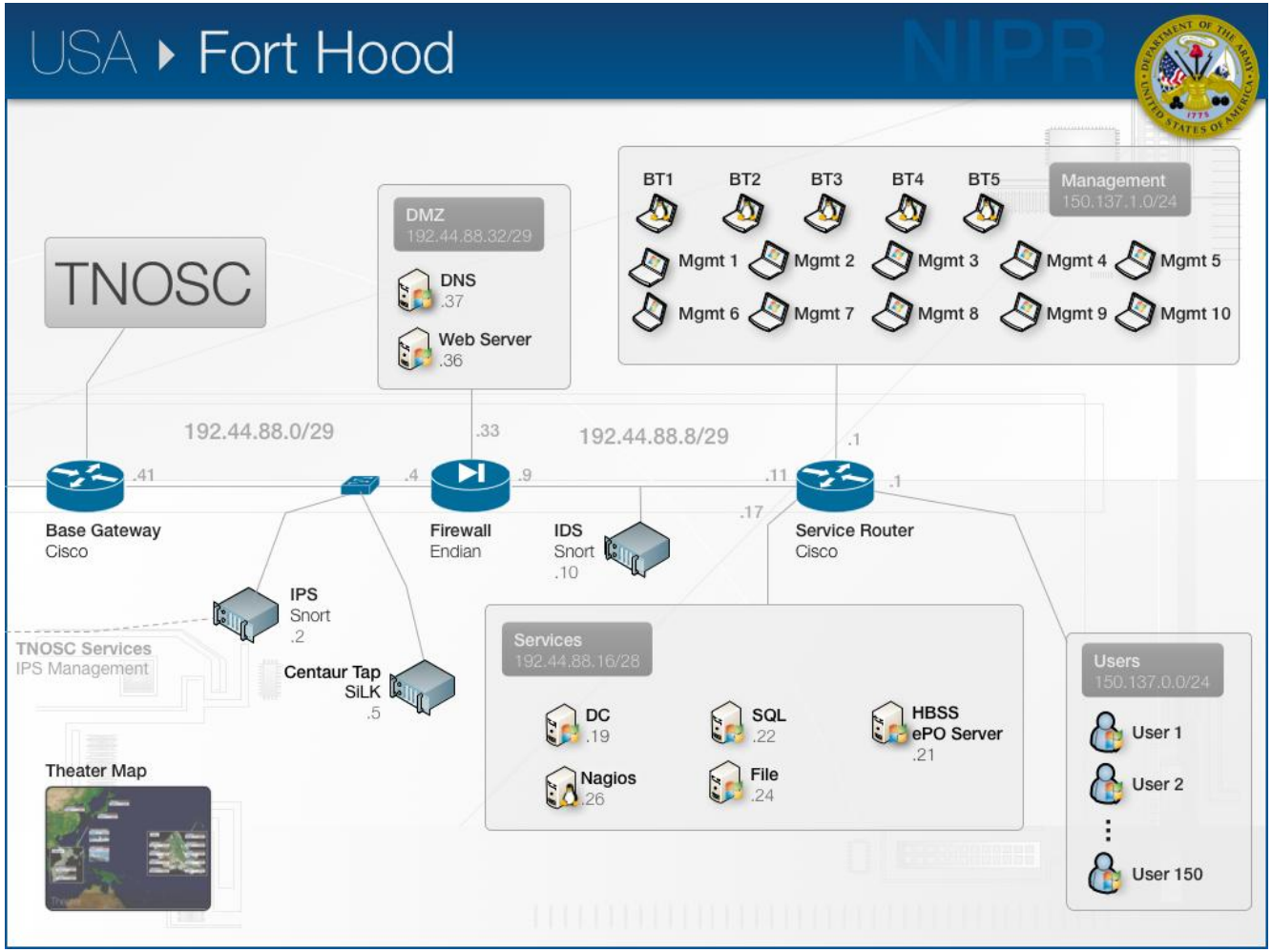
Actions: Login to Arcsight from Mgmt machines

What to look for: port scan notifications

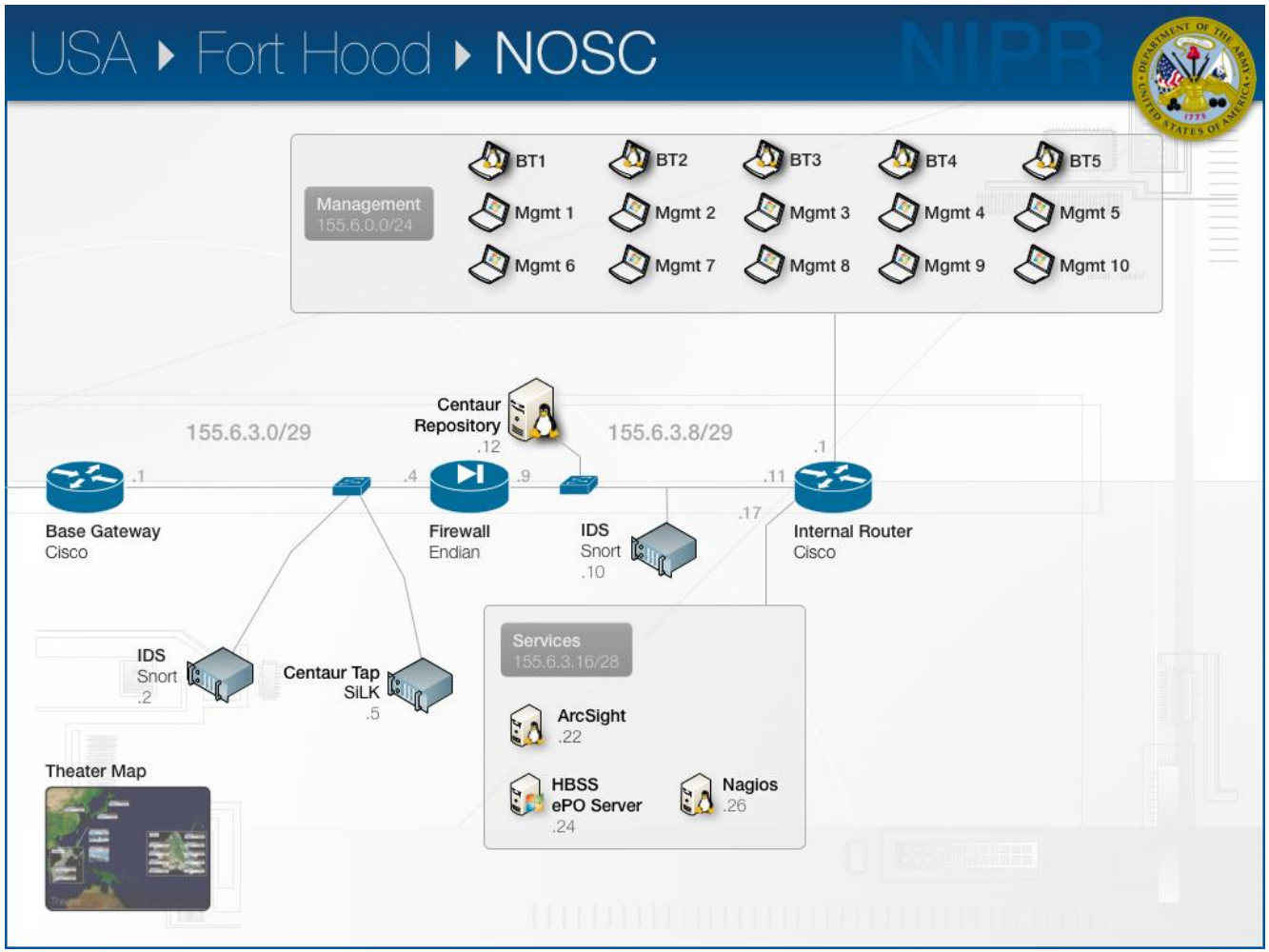
Highlights: Arcsight

Exercise Environment

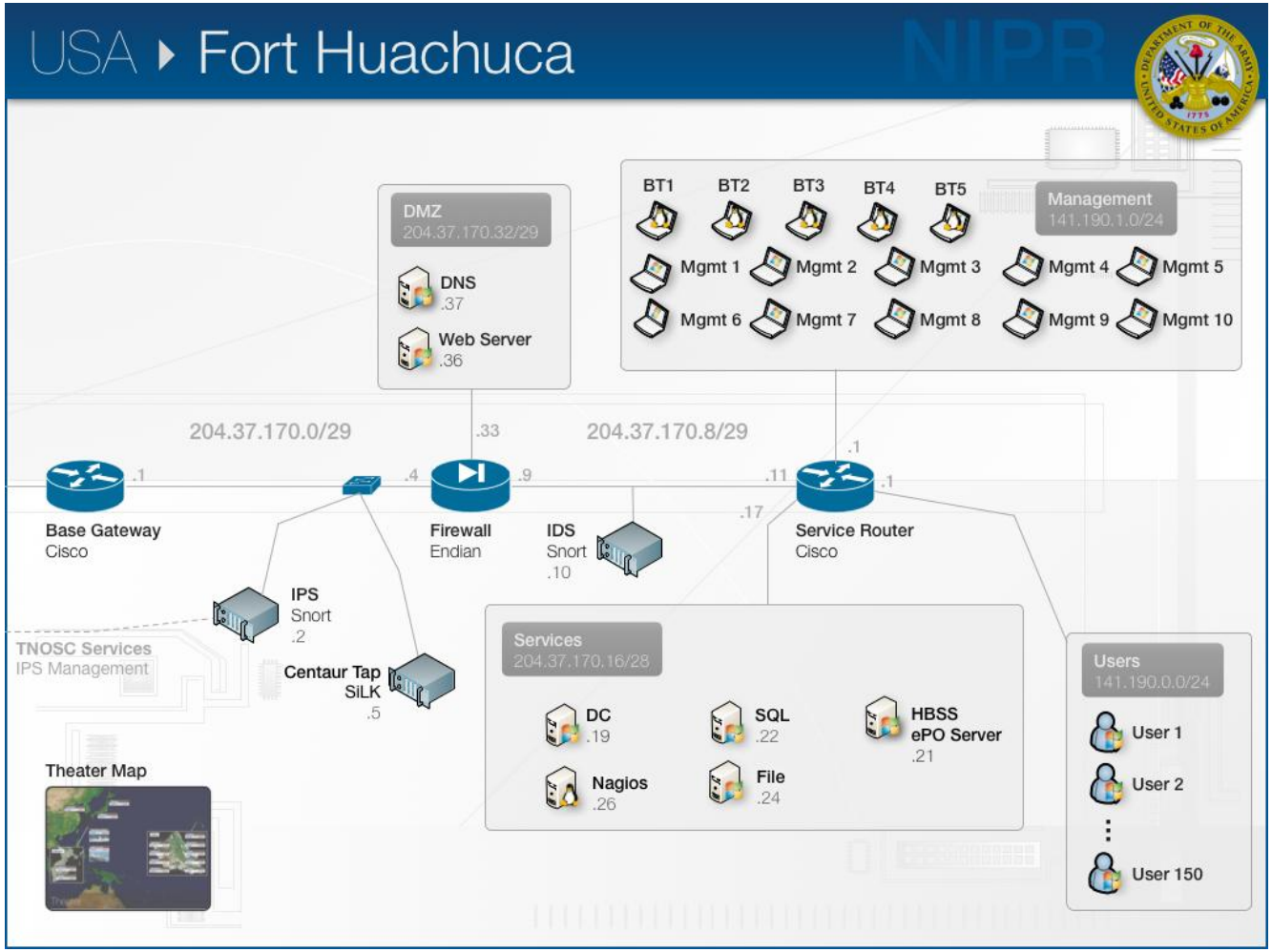
Exercise Environment (continued)



Exercise Environment (continued)



Exercise Environment (continued)



Scenario Overview (continued)

User scanning

Zones: Hood, Huachuca

Actions: Use retina on Mgmt machine to scan user subnet

WTLF: # hosts unpatched (IPs:…)

Highlights: Retina, Nessus

Scenario Overview (continued)

SQL Injection

Zones: Hood

Actions: Have Arcsight Open from Mgmt machines

WTLF:

‘SQL Injection’ and ‘TFTP’ log entries

Web logs with attack string

Highlights: Arcsight

Scenario Overview (continued)

Data Exfiltration

Zones: Huachuca

Actions: Open wireshark on internal and external snort

WTLF: data packets from 3 exfiltrations; all 3 send ‘Sherlock Holmes’ over the wire

Highlights: Wireshark

Scenario Overview (continued)

Create HBSS ePo report (time permitting)

Zones: NOSC, Hood, Huachuca

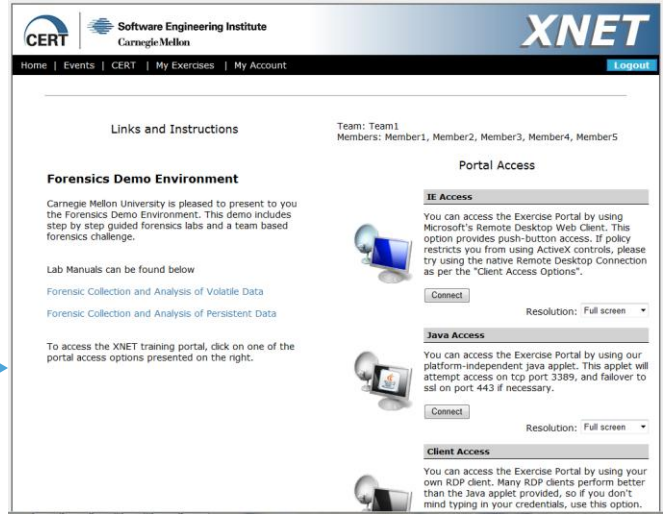
Actions: Connect to ePo server and generate report on users

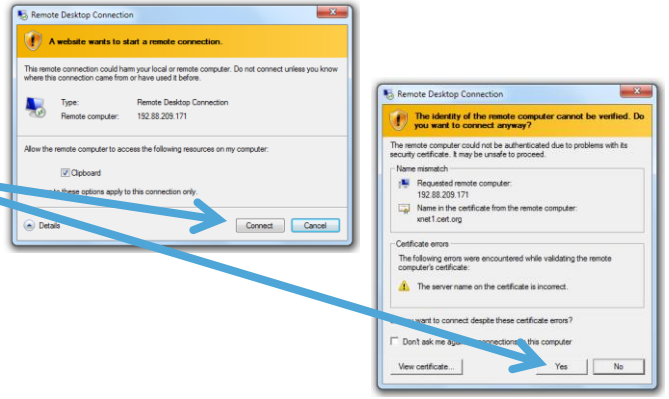
WTLF: ePo interface and report

Highlights: HBSS ePo

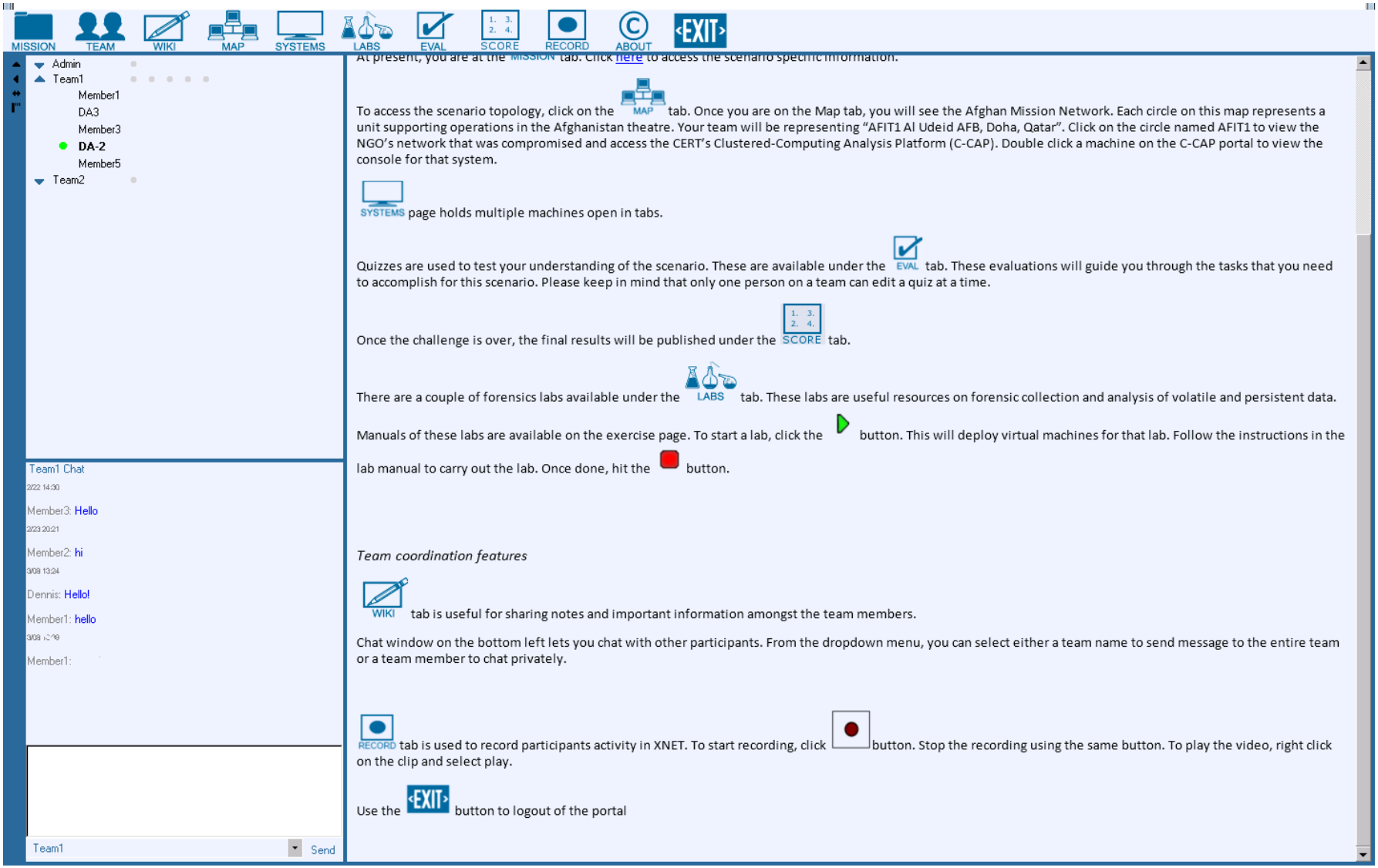
Exercise Login

1. Please open Internet Explorer and navigate to http://xnet.cert.org
2. Please click on the green LOGIN button in the upper right hand corner.
3. Please login using the credentials on your name placard in front of you.
4. Your screen should now appear similar to the one at the right.
5. Please click on the “Connect” button under IE Access.
6. You may be prompted about allowing the RDP client to access the website and about accepting the self-signed certificate. Please click on “Connect” and “Yes” respectively.
7. Once you are logged in, please give one of our instructors a thumbs up.





Welcome to XNET



Scenario Overview

Stage 1:

Normal chaff

- User internet traffic
- Local domain traffic
- Typical external port scanning (e.g., port 22, 80, etc.)

Vulnerability analysis

- Network situational awareness (benchmark)

Stage 2:

Increased external probing

- DoS

Sensor familiarization

Illegal software installed

Stage 3:

Intrusion detection

SQL injection

IRC chat

Stage 4:

Intrusion detection:

Insider threat

DoS

Data exfiltration

Easy/medium/hard

Malicious PDF released (malware)

Detection of malicious file, processes, etc.

Stage 5:

Threat analysis of malware

Debrief

Scenario Execution

“Weapons Free”

Scenario Wrap Up – Review Stage 1

CDAP:

- Analyze 4 servers, 20 users
- Identify 1 host w/o SP
- Identify 1 server missing a patch
- Identify 1 server running anonymous FTP

CND:

- Establish baseline w/Arcsight, Snort
- Find open ports of concern on firewall (23, 37331, etc.)

IH:

- Run Retina scans (Findings?)

Scenario Wrap Up – Review Stage 2

CDAP:

- Find unauthorized software installations
- 2 occurrences on different hosts

CND:

- Identify and blacklist problem IPs (external)

IH:

- Remediate vulnerabilities and threats

Scenario Wrap Up – Review Stage 3

CDAP:

- Identify problem areas that allowed for SQL Injection
- No data validation on web page
- Vulnerable SQL server

CND:

- Identify user machine and external IP talking via IRC
- Find SNORT alerts relating to IRC and SQL Inject

IH:

- Remediate vulnerabilities and threats

Scenario Wrap Up – Review Stage 4

CDAP:

- Stop exfiltration attacks from occurring
- Determine where malware originated (internal IP address)

CND:

- Detect 3 exfiltration attempts: easy/med/hard
- What type? Any payload/file?
- Internal/External IPs
- Identify a DoS occurring from inside the network
- Source and destination IPs (ipv6?)
- Identify malware on the network

IH:

- Remediate vulnerabilities and threats
- Identify malware (malicious PDF)

Conclusion

On behalf of Carnegie Mellon University, the Software Engineering Institute, and the CERT Enterprise and Workforce Management Directorate, thank you for your time today.

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