Software Assurance:

Enabling Enterprise Resilience through Security Automation and Software Supply Chain Risk Management

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SOFTWARE ASSURANCE FORUM

Homeland Security

Commerce

National Defense

BUILDING SECURITY IN

Public/Private Collaboration Efforts for Security Automation and Software Supply Chain Risk Management

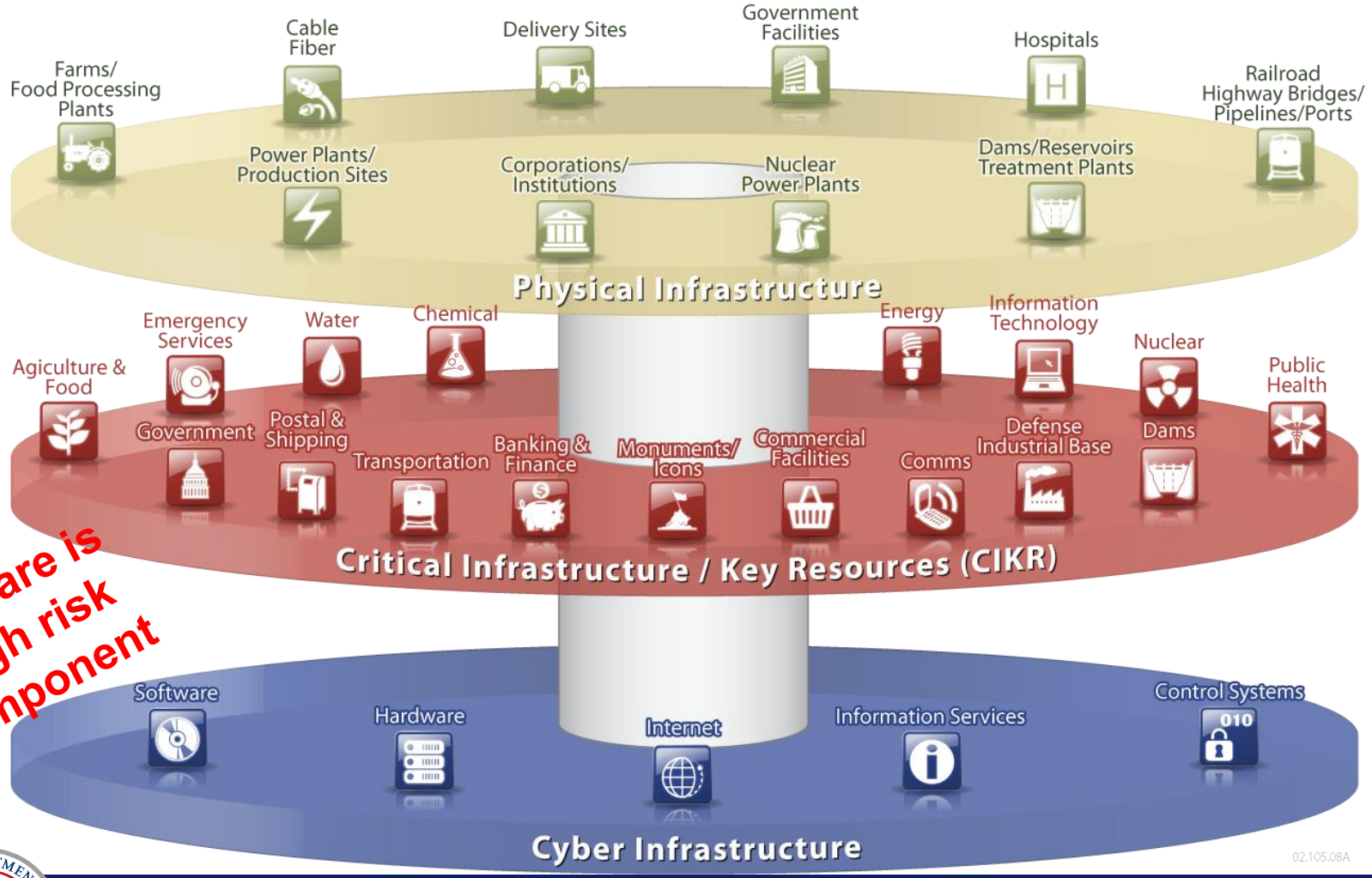
Next SwA Forum sessions: 5-7 March 2013 at NIST in Gaithersburg MD

Interdependencies Between Physical & Cyber –
Convergence of Safety, Security and Resilience Considerations

In an era riddled with asymmetric cyber attacks, claims about system reliability and safety must include provisions for built-in security of the enabling software

Interdependencies Between Physical & Cyber Infrastructures:
Convergence of Safety, Security and Dependability Considerations

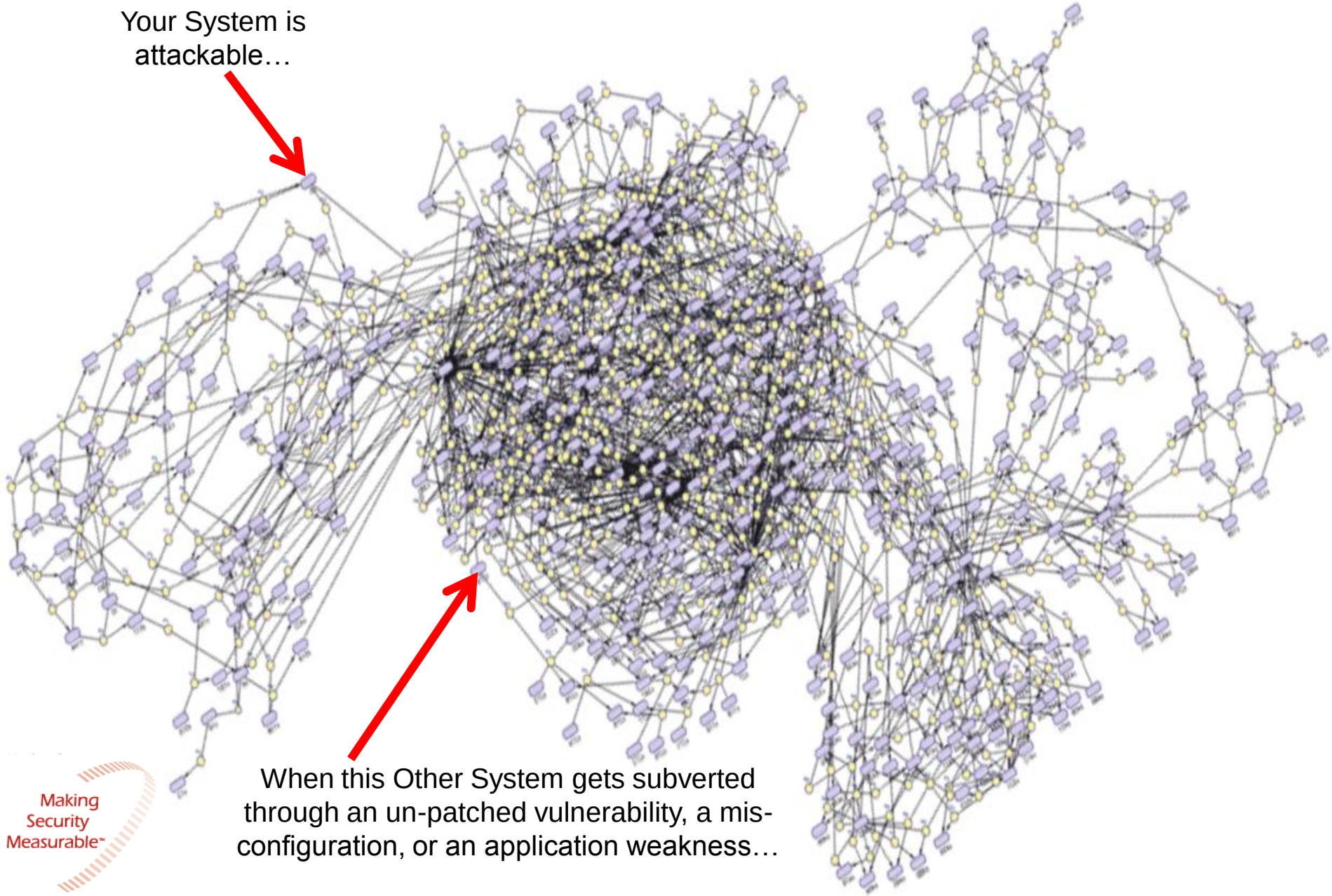
-- Need for secure/resilient software applications



Software is a high risk component

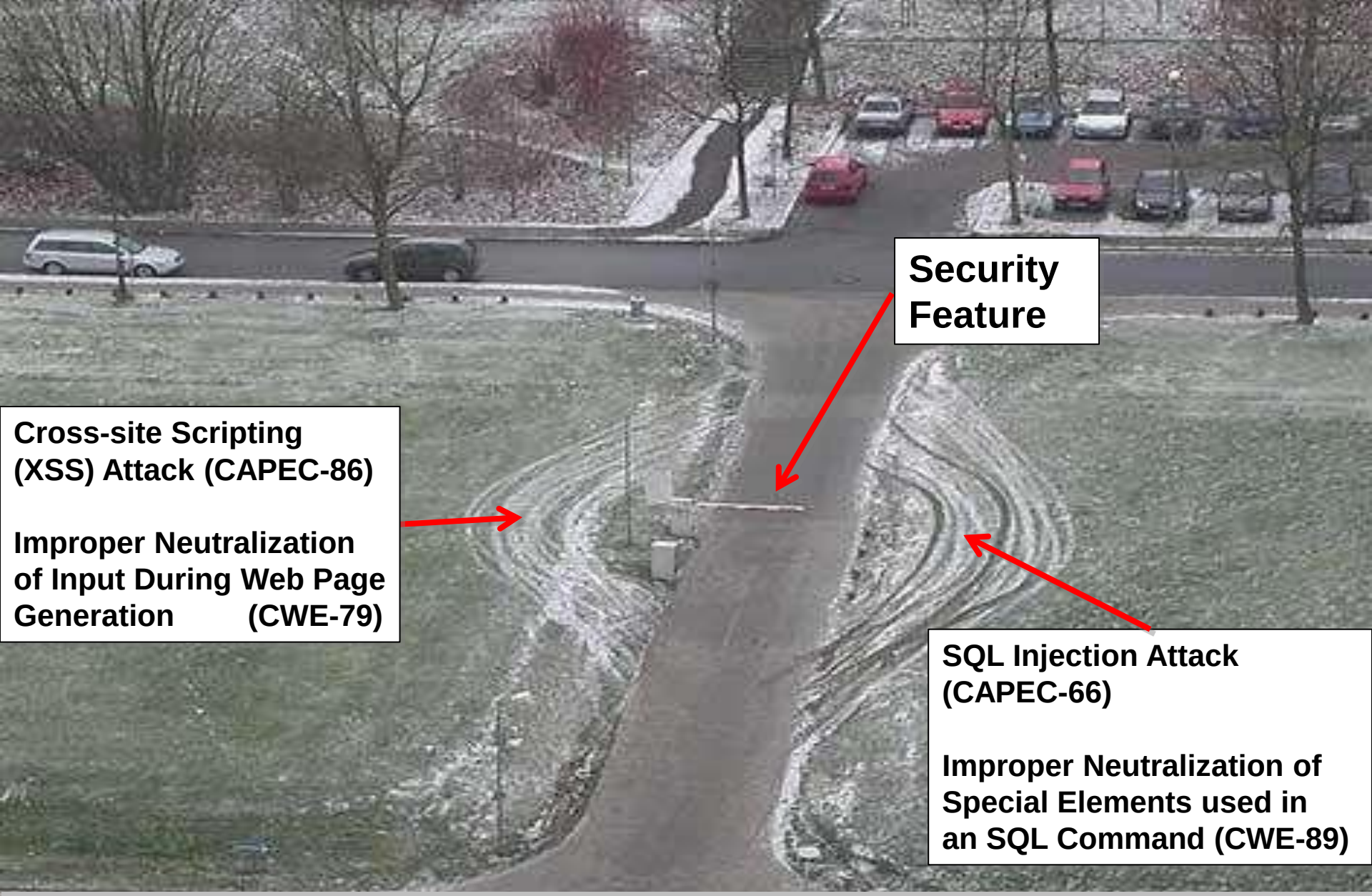
Today Everything's Connected

Your System is attackable…



When this Other System gets subverted through an un-patched vulnerability, a mis-configuration, or an application weakness…

Making Security Measurable™



Exploitable Software Weaknesses (CWEs) are sources for future Zero-Day Attacks

Security is a Requisite Quality Attribute: Vulnerable Software Enables Exploitation

- Rather than attempt to break or defeat network or system security, hackers are opting to target application software to circumvent security controls.
  - **75% of hacks occurred at application level**
    - "90% of software attacks were aimed at application layer" (Gartner & Symantec, June 2006)
  - most exploitable software vulnerabilities are attributable to non-secure coding practices (and not identified in testing).
- Functional correctness must be exhibited even when software is subjected to abnormal and hostile conditions

In an era riddled with asymmetric cyber attacks, claims about system reliability, integrity & safety must include provisions for built-in security of the enabling software.

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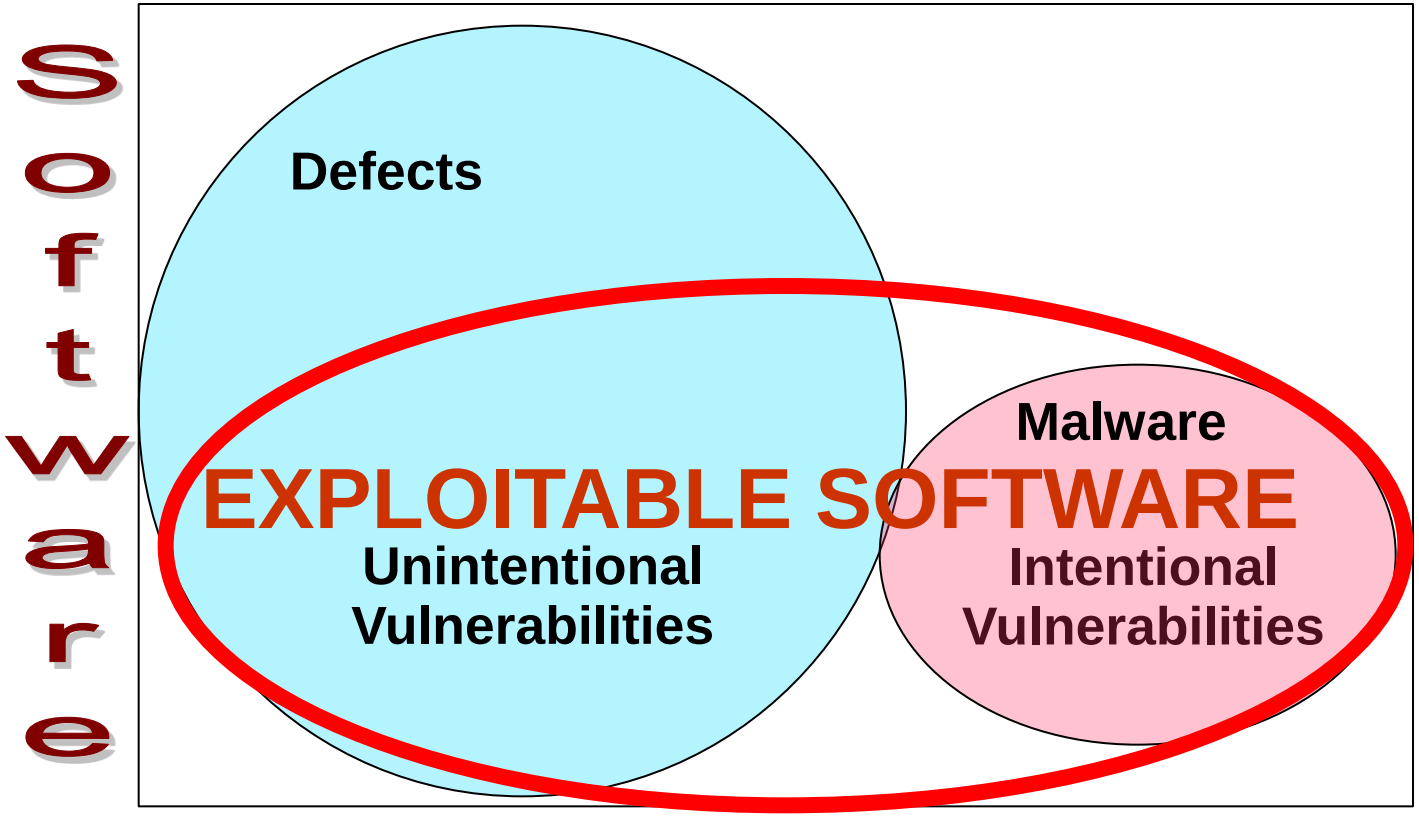
Software Assurance Addresses Exploitable Software:
Outcomes of non-secure practices and/or malicious intent

Exploitation potential of vulnerability is independent of "intent"



'High quality' can reduce security flaws attributable to defects; yet traditional S/W quality assurance does not address intentional malicious behavior in software

*Intentional vulnerabilities: spyware & malicious logic deliberately imbedded (might not be considered defects)

Software Assurance (SwA) is the level of confidence that software functions as intended and is free of vulnerabilities, either intentionally or unintentionally designed or inserted as part of the software throughout the life cycle.*

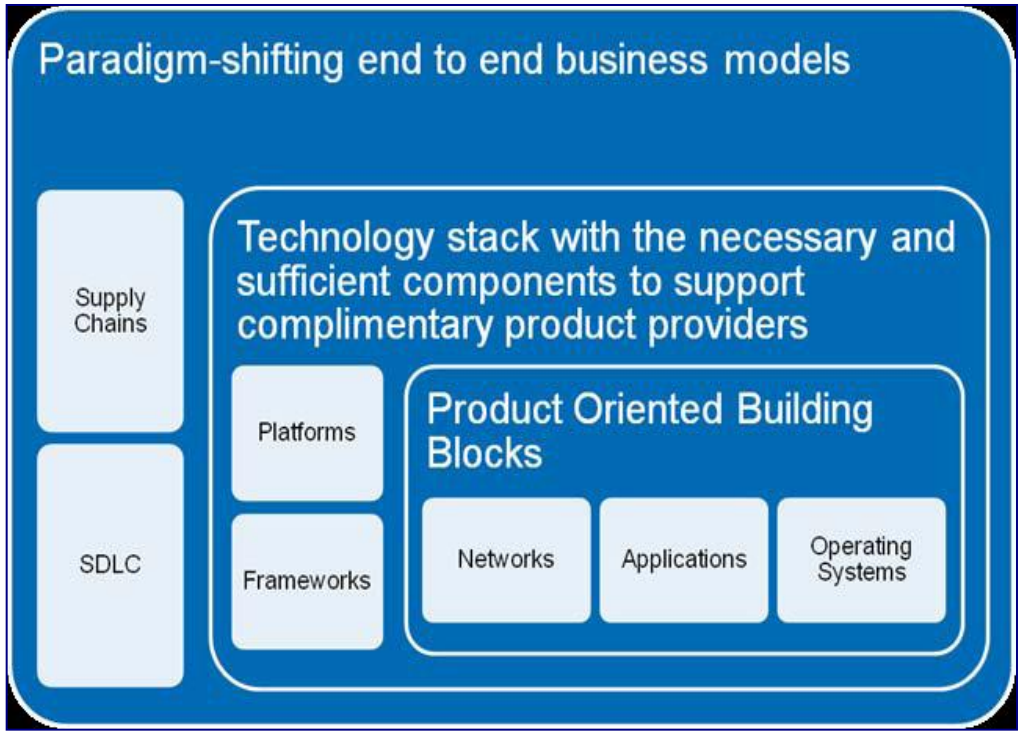
From CNSS Instruction 4009 "National Information Assurance Glossary" (26APR2010)

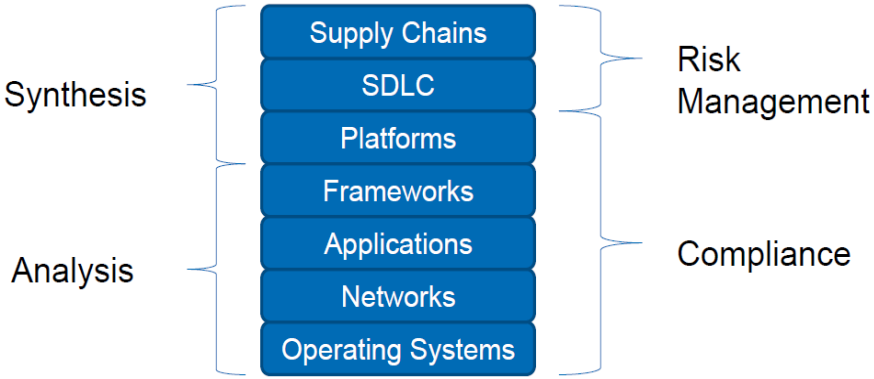
IT/software security risk landscape is a convergence between “defense in depth” and “defense in breadth”

Enterprise Risk Management and Governance are security motivators

Acquisition could be considered the beginning of the lifecycle; more than development

> “In the digital age, sovereignty is demarcated not by territorial frontiers but by supply chains.”
>
> – Dan Geer, CISO In-Q-Tel





Software Assurance provides a focus for:

-- Secure Software Components,

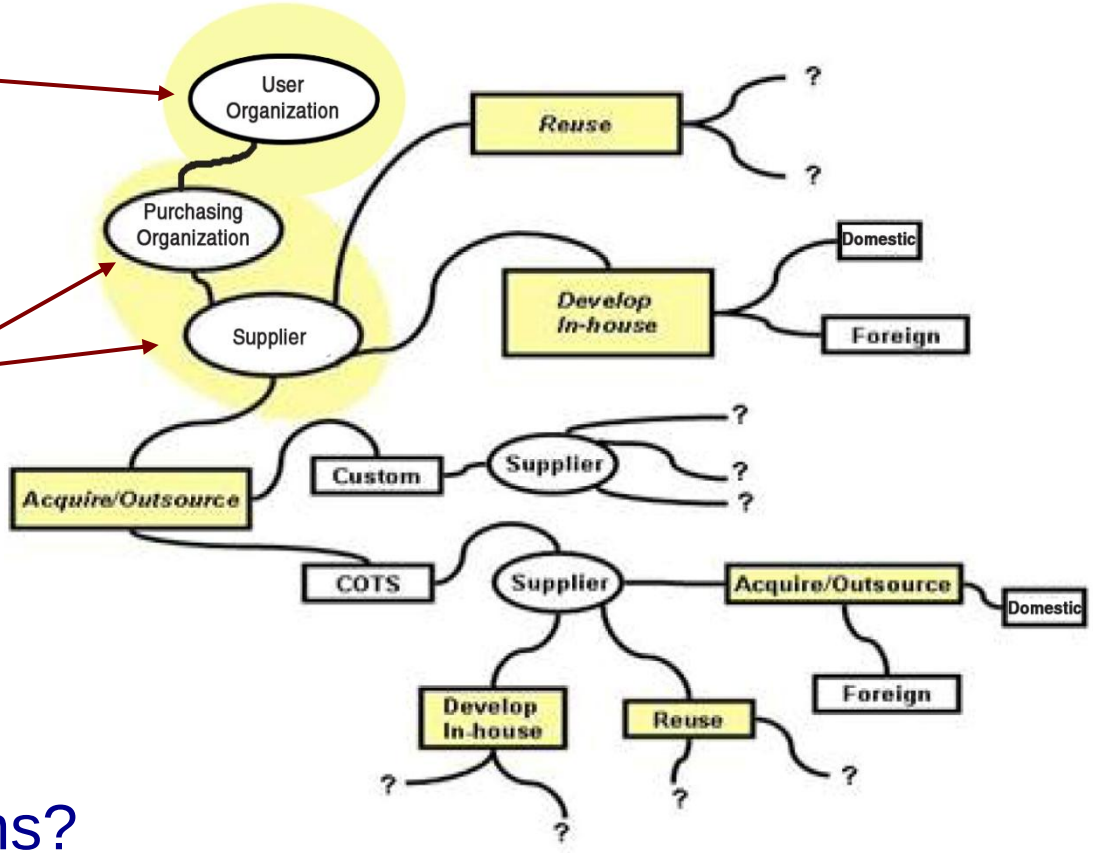
-- Security in the Software Life Cycle,

-- Software Security in Services, and

-- Software Supply Chain Risk Management

Risk Management (Enterprise ⟷ Project):
Shared Processes & Practices ⟷ Different Focuses

- Enterprise-Level:
  - Regulatory compliance
  - Changing threat environment
  - Business Case
- Program/Project-Level:
  - Cost
  - Schedule
  - Performance



Who makes risk decisions?

Who "owns" residual risk from tainted/counterfeit products?

* "Tainted" products are those that are corrupted with malware, or exploitable weaknesses & vulnerabilities that put users at risk

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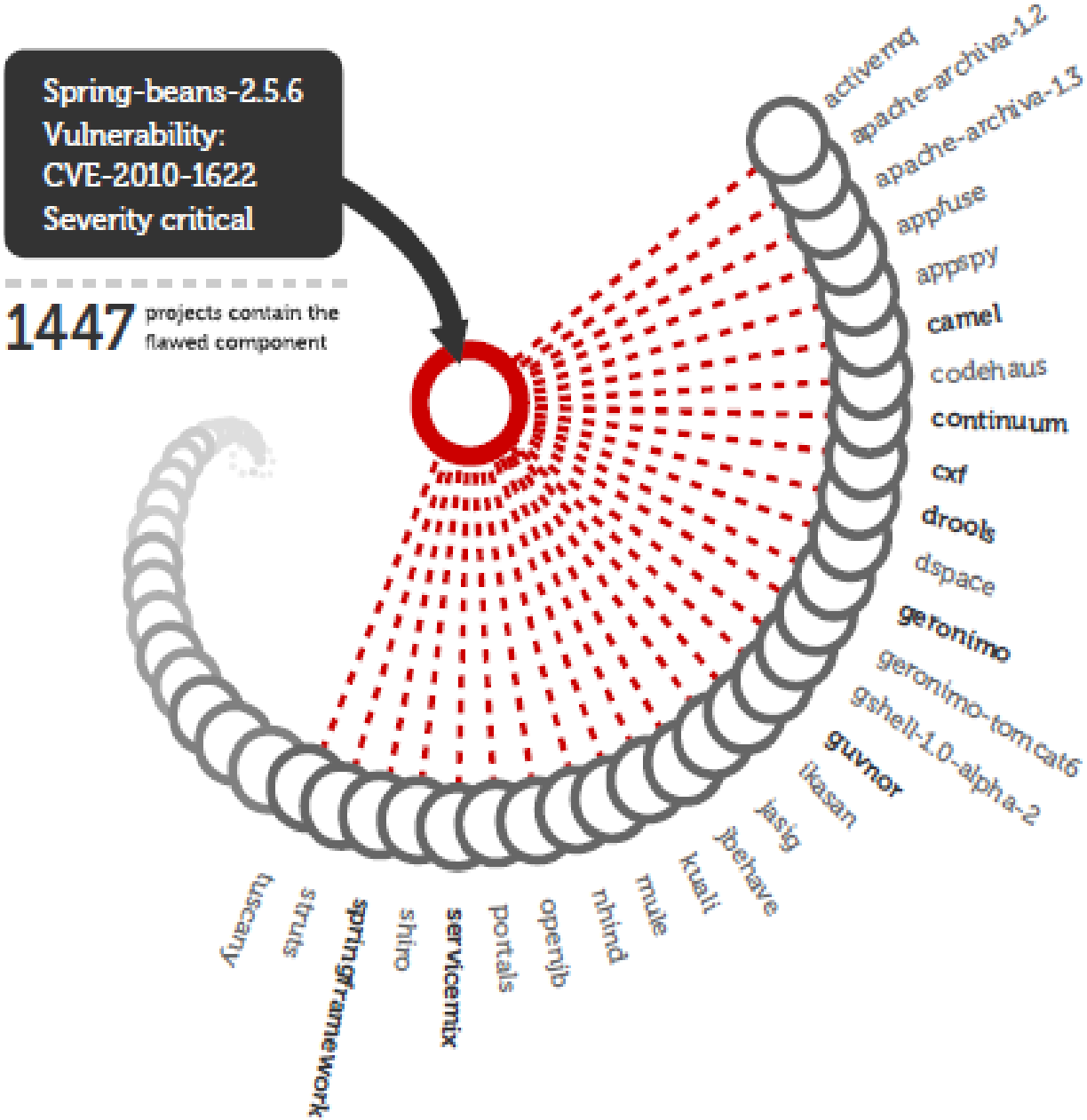
Even after vulnerabilities are discovered and patches made available, many developers use the flawed, non-patched version of reused components



Who makes risk decisions?

Who inherits the residual risk?

Who 'owns' the residual risk attributable to exploitable software?

Source: Maximizing Benefits and Mitigating Risks of Open Source Components in Application Development, by Sonatype

Assessment Challenges of Multiple Platforms

Operating System	+ CPU	+ Compiler	+ Libraries
	AMD intel Sun microsystems	Gcc MS Visual Studio IAR Sun CC Greenhills Diab	OS libraries C library Networking Thread libraries Crypto
x	x	x	x
multiple distros	32-bit 64-bit	compiler flags	multiple versions

Challenges in Mitigating Risks Attributable to Exploitable Software and Supply Chains

- Complexity hampers ability to determine and predict code behavior; so any “assurance” claims for security/safety-critical applications are limited.
- Without adequate diagnostic capabilities and commonly recognized standards from which to:
  - discern product assurance;
  - benchmark process capabilities, and
  - assert claims about the assurance of products, systems and services,
- “provenance and pedigree of supply chain actors” become a more dominant consideration for security/safety-critical applications:
  - Enterprises and Users lack requisite transparency for more informed decision-making for mitigating risks;
  - Favoring domestic suppliers does not necessarily address ‘assurance’ in terms of capabilities to deliver secure/safe components, systems or software-reliant services.

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Challenges in Mitigating Risks Attributable to Exploitable Software and Supply Chains (cont.)

- Several needs arise:
  - Need internationally recognized standards to support security automation and processes to provide transparency for more informed decision-making for mitigating enterprise risks.
  - Need ‘Assurance’ to be explicitly addressed in standards & capability benchmarking models for organizations involved with security/safety-critical applications.
  - Need more comprehensive diagnostic capabilities to provide sufficient evidence that “code behavior” can be well understood to not possess exploitable or malicious constructs.
  - Need rating schemes for software products and supplier capabilities.

Mitigating Risks Attributable to Exploitable Software and Supply Chains

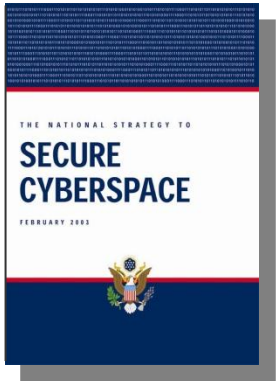
Enterprises seek comprehensive capabilities to:

- Avoid accepting software with **MALWARE** pre-installed. **MAEC**
- Determine that no publicly reported **VULNERABILITIES** remain in code prior to operational acceptance, and that future discoveries of common vulnerabilities and exposures can be quickly patched. **CVE**
- Determine that exploitable software **WEAKNESSES** that put the users most at risk are mitigated prior to operational acceptance or after put into use. **CWE**

DHS Software Assurance Program Overview

- Program established in response to the National Strategy to Secure Cyberspace - Action/Recommendation 2-14:

  "DHS will facilitate a national public-private effort to promulgate best practices and methodologies that promote integrity, security, and reliability in software code development, including processes and procedures that diminish the possibilities of erroneous code, malicious code, or trap doors that could be introduced during development."



- DHS Program goals promote the **security and resilience** of software across the development, acquisition, and operational life cycle
- DHS Software Assurance (SwA) program is scoped to address:
  - **Trustworthiness** - No exploitable vulnerabilities or malicious logic exist in the software, either intentionally or unintentionally inserted,
  - **Dependability (Correct and Predictable Execution)** - Justifiable confidence that software, when executed, functions as intended,
  - **Survivability** - If compromised, damage to the software will be minimized; it will recover quickly to an acceptable level of operating capacity; it's 'rugged';
  - **Conformance** – Planned, systematic set of multi-disciplinary activities that ensure processes/products conform to requirements, standards/procedures.

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See Wikipedia.org for "Software Assurance" - CNSS Instruction No. 4009, "National Information Assurance Glossary," Revised 2006, defines Software Assurance as: "the level of confidence that software is free from vulnerabilities, either intentionally designed into the software or accidentally inserted at anytime during its lifecycle, and that the software functions in the intended manner".

DHS CS&C Software Assurance (SwA) Program

Advances security and resilience of software throughout the lifecycle; focuses on reducing exploitable software weaknesses and addresses means to improve capabilities that routinely develop, acquire, and deploy resilient software.

- **Serves as a focal point for interagency public-private collaboration to enhance development and acquisition processes, capability benchmarking and rating schemes to address software security needs.**
  - Hosts interagency Software Assurance Forums, working groups and training to provide public-private collaboration in advancing software security and providing publicly available resources.
  - Provides collaboratively developed, peer-reviewed information resources on Software Assurance, via journals, guides & on-line resources suitable for use in education, training, and process improvement.
  - Provides input and criteria for leveraging international standards and maturity models used for process improvement and capability benchmarking of software suppliers and acquisition organizations.

- **Enables software security automation and measurement capabilities through use of common indexing and reporting capabilities for malware, exploitable software weaknesses, cyber indicators and attacks which target software.**
  - Collaborates with national & international standards organizations and industry to create standards, metrics and certification mechanisms from which products and tools could be qualified for software security verification.
  - Manages programs for Malware Attribute Enumeration Classification (MAEC), Common Weakness Enumeration (CWE), Common Attack Pattern (CAPEC) & Cyber Observable eXpression (CybOX).
  - Manages programs for Common Vulnerabilities & Exposures (CVE) and Open Vulnerability & Assessment Language (OVAL) that provide information feeds for continuous monitoring, security content automation, vulnerability databases, and security/threat alerts from many organizations

Software Assurance Forum & Working Groups*

… encourage the production, evaluation and acquisition of more secure and resilient software through targeting:

People	Processes	Technology	Acquisition
Developers and users education & training	Sound practices, standards, & practical guidelines for secure software development	Security test criteria, measurement, diagnostic tools, common languages & enumerations, SwA Research & Development	Software security improvements through due-diligence questions, specs and guidelines for acquisitions/ outsourcing

Products and Contributions

Build Security In - https://buildsecurityin.us-cert.gov and SwA community resources & info clearinghouse

SwA Common Body of Knowledge (CBK) & Glossary
Organization of SwSys Security Principles/Guidelines
SwA Developers' Guide on Security-Enhancing SDLC

SwA Curriculum Project: Masters and Undergraduate

Software Security Assurance State of the Art Report

Systems Assurance Guide (via DoD and NDIA)

SwA-related standards – ISO/IEC JTC1 SC7/27/22, IEEE CS, OMG, TOG, & CMM-based Assurance

Practical Measurement Framework for SwA/InfoSec
Making the Business Case for Software Assurance

SwA Metrics & Tool Evaluation (with NIST)
SwA Ecosystem w/ DoD, NSA, NIST, OMG & TOG
NIST Special Pub 500 Series on SwA Tools

Security Automation Enumerations & Languages (CVE, OVAL, CWE, CAPEC, MAEC, CybOX, STIX), scoring systems, and risk analysis capabilities

SwA in Acquisition: Mitigating Risks to Enterprise Software Project Management for SwA SOAR

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* SwA Forum is part of Cross-Sector Cyber Security Working Group (CSCSWG) established under auspices of the Critical Infrastructure Partnership Advisory Council (CIPAC) that provides legal framework for participation.

DHS Software Assurance (SwA) Outreach & Awareness

- Co-sponsor SwA working group sessions, semi-annual SwA Forum, for government, academia, and industry to facilitate ongoing public-private collaboration.
- Provide SwA presentations, workshops, and tracks at conferences
- Co-sponsor SwA issues of CROSSTALK to "spread the word"
  - Sep 2008 issue on "Application Security"
  - Mar/Apr 2009 issue on "Reinforcing Good Practices"
  - Sep/Oct 2009 issue on "Resilient Software"
  - Mar/Apr 2010 issue on "System Assurance"
  - Sep/Oct 2010 issue on "Game Changing Tools & Practices"
  - Mar/Apr 2011 issue on "Rugged Software"
  - Sep/Oct 2011 issue on "Protecting against Predatory Practices"
  - Mar/Apr 2012 issue on "Securing a Mobile World"
  - Sep/Oct 2012 issue on "Resilient Cyber Ecosystem"
  - Mar/Apr 2013 issue on "Supply Chain Risk Management"
- Collaborate with standards organizations, consortiums, professional societies, education/training initiatives in promoting SwA
- Provide free SwA resources via "BuildSecurityIn" website to promote secure development methodologies (since Oct 05)
- Host SwA Community Resources & Information Clearinghouse via https://buildsecurityin.us-cert.gov/SwA (since Dec 07)

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SwA Collaboration for Content & Peer Review

BSI https://buildsecurityin.us-cert.gov focuses on making Software Security a normal part of Software Engineering

SwA Community Resources and Information Clearinghouse (CRIC)

https://buildsecurityin.us-cert.gov/swa/ focuses on all contributing disciplines, practices and methodologies that advance risk mitigation efforts to enable greater resilience of software/cyber assets.

The SwA CRIC provides a primary resource for SwA Working Groups.

Where applicable, SwA CRIC & BSI provide relevant links to each other.

Life-Cycle Standards View Categories (ISO/IEC 15288 and 12207)

Organization

Governance Processes

Strategy and policy

Enterprise risk management
- Compliance
- Business case

Supply Chain Management

Project-Enabling Processes

Life Cycle Model Management

Infrastructure Management
- SwA ecosystem
- Enumerations, languages, and repositories

Project Portfolio Management

Human Resource Management
- SwA education
- SwA certification and training
- Recruitment

Quality Management

Agreement Processes

Acquisition
- Outsourcing
- Agreements
- Risk-based due diligence
- Supplier assessment

Supply

Project

Project Management Processes

Project Planning

Project Assessment and Control
- Assurance case management

Project Support Processes

Decision Management

Risk Management
- Threat Assessment

Configuration Management

Information Management

Measurement

Engineering

Technical Processes

Stakeholder Requirements Definition

Requirements Analysis
•Attack modeling (misuse and abuse cases)
•Data and information classification
•Risk-based derived requirements
•Sw security requirements

Architectural Design
•Secure Sw architectural design
•Risk-based architectural analysis
•Secure Sw detailed design and analysis

Implementation
•Secure coding and Sw construction
•Security code review and static analysis
•Formal methods

Integration
•Sw component integration
•Risk analysis of Sw reuse components

Verification & Validation
•Risk-based test planning
•Security-enhanced test and evaluation
- Dynamic and static code analysis
- Penetration testing

•Independent test and certification

Transition
•Secure distribution and delivery
•Secure software environment (secure configuration, application monitoring, code signing, etc)

Operations and Sustainment

Operation
- Incident handling and response

Maintenance
- Defect tracking and remediation
- Vulnerability and patch management
- Version control and management

Disposal

Software Reuse Processes

Domain Engineering

Reuse Asset Management

Reuse Program Management

Software Support Processes

Sw Documentation Management

Sw Quality Assurance

Sw Configuration Management

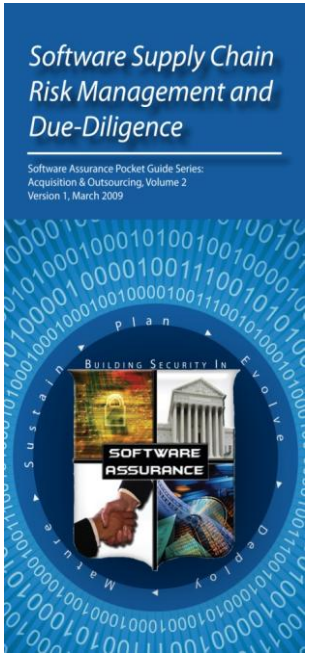
Sw Verification & Sw Validation

Sw Review

Sw Audit

Sw Problem Resolution

Software Assurance (SwA) Pocket Guide Series



SwA in Acquisition & Outsourcing

- Software Assurance in Acquisition and Contract Language
- Software Supply Chain Risk Management and Due-Diligence

SwA in Development *

- Risk-based Software Security Testing
- Requirements and Analysis for Secure Software
- Architecture and Design Considerations for Secure Software
- Secure Coding and Software Construction
- Key Practices for Mitigating the Most Egregious Exploitable Software Weaknesses

* Include questions to ask developers

SwA Life Cycle Support

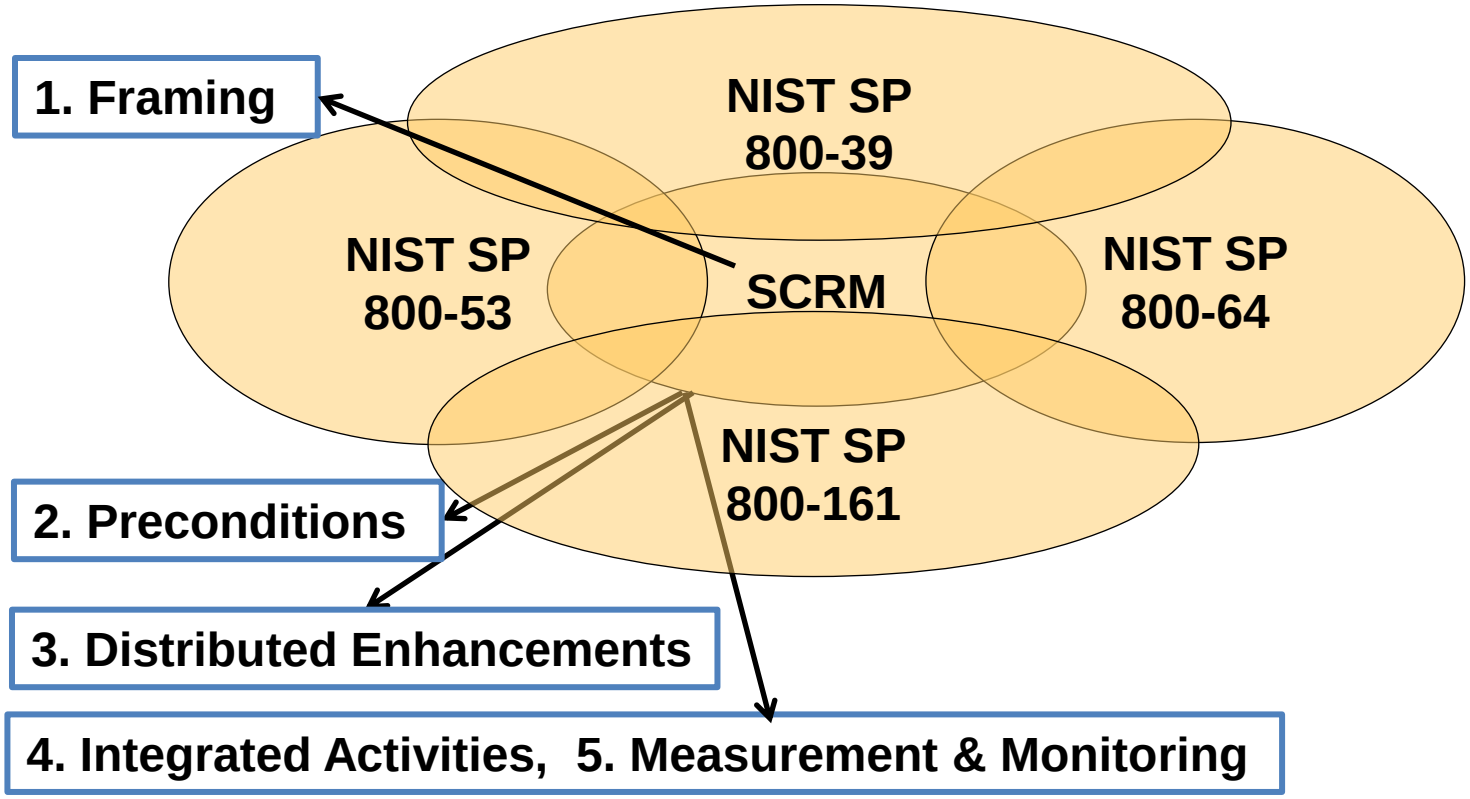
- SwA in Education, Training and Certification

SwA Pocket Guides and SwA-related documents are collaboratively developed with peer review; they are subject to update and are freely available for download via the DHS Software Assurance Community Resources and Information Clearinghouse at https://buildsecurityin.us-cert.gov/swa (see SwA Resources)

Objectives for SCRM & SwA in Acquisition

- we need "systems-of-systems" or "enterprise systems" thinking for risk management (building on 800-39 and 800-64)
- IT Baselines for SCRM & SwA should build on 800-53

Secure It Or Don't Procure It



Applying Relevant Guidance to SCRM

Industry and NIST Documents as well as other inputs that will shape the development of NIST SP800-161:

- 800-39
- 800-30rev1
- 800-53rev4
- FIPS 199
- NIST IR on SCRM
- SCRM Workshop Feedback
- Inputs from other organizations: Open Group, OMG, ISO/IEC JTC1, SafeCode, etc.

Supply Chain Risk Management

- SCRM is an enterprise activity that impacts organizational, mission, and operational layers. Must ensure coverage of all layers within the risk management structure.
- SCRM SP will be based on risk management and its process (NIST SP 800-39)
  - Frame (F)
  - Assess (A)
  - Respond (R)
  - Monitor (M)
- Supply chain risk management will incorporate
  - Criticality Analysis; FIPS 199 (only high & moderate necessitate SCRM)
  - Threat
  - Vulnerabilities

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NIST SCRM SP 161

INTRODUCTION

1.1 PURPOSE AND APPLICABILITY
1.2 TARGET AUDIENCE
1.3 RELATIONSHIP TO OTHER PUBLICATIONS
1.4 ORGANIZATIONAL RESPONSIBILITIES
1.5 ORGANIZATION OF THIS SPECIAL PUBLICATION

THE FUNDAMENTALS

2.1 SUPPLY CHAIN RISK MANAGEMENT
2.2 ASSURANCE AND TRUSTWORTHINESS

THE PROCESS

3.1 FRAMING SUPPLY CHAIN CONCERNS
3.2 ASSESSING SUPPLY CHAIN CONCERNS
3.3 RESPONDING TO THE SUPPLY CHAIN CONCERNS
- SCRM GUIDANCE / BASELINES
- TAILORING BASELINE SCRM GUIDANCE
- DOCUMENTING THE GUIDANCE SELECTION PROCESS
- DOCUMENTING THE GUIDANCE FOR CONTINUOUS MONITORING

3.4 MONITORING FOR SUPPLY CHAIN ASSURANCE
- DOCUMENTING THE GUIDANCE FOR CONTINUOUS MONITORING

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The Fundamentals

- SUPPLY CHAIN RISK MANAGEMENT

  Defines the structure and elements of SCRM

  - Risk Management Pyramid

    (using the Frame, Assess, Respond, Monitor -FARM Process)
  - Relationship between Organizational, Business and Operational layers addressed with respect to SCRM
  - Scope of baseline guidance – what the baseline guidance will cover
  - How to verify if guidance is sufficient to address SCRM for the specific agency

- ASSURANCE AND TRUSTWORTHINESS
  - Address the criticality and FIPS 199 processes
  - Discuss threats – both assumed and new
    - How threats may be scoped and how they tie into criticality & influence SCRM
  - Discuss vulnerabilities – both assumed and new
    - How vulnerabilities may be scoped and how they tie into criticality & influence SCRM
  - Describe users/acquirers and their relationship with suppliers

The Process

This Section (Chapter 3) walks the acquirer through the SCRM implementation process using FARM.

Frame (F):

Provides the acquirer with the foundational structure to address the various threats and vulnerabilities to manage SCRM

- Defines the Scope including criticality, threat and vulnerability landscape of the supply chain system/component
- Discusses the various organizational and business/mission requirements and constraints that may apply
- List of information sources for acquirer to reach out to for obtaining relevant data/information for supply chain risk assessment.

The Process

Assess (A):

Provides the structure for agency specific assessment where organization specific SCRM context can be defined enabling the assessment of specific threat or vulnerability condition for impact.

- Define the specific threats and vulnerabilities within the context of the organizational threat landscape and organizational vulnerability landscape.
- Identify the various non-compliance or non-conformance issues that may contribute to the supply chain risk.
- Identify the stakeholders potentially impacted by the vulnerability or threat.
- Assess the overall impact of the vulnerability or threat in the context of the specific supply chain issue.

The Process

Respond (R):

Discusses the SCRM guidance as it pertains to the organizational, business, and operational layers of landscape for addressing SCRM.

- **SCRM Guidance/Baseline**

  Lists SCRM reference documents and guidance that can be leveraged by the acquirer.

- **Tailoring SCRM Guidance/Baseline**

  Provides a more tailored approach for choosing the relevant guidance that may pertain to that specific organizational needs.

- **Documenting the Guidance Selection Process**

  Discusses the traceability and reasoning for specific SCRM guidance for a specific agency and situation. There is a tie to existing 800-53 controls where relevant and any enhanced measures required for managing risk.

  (Use applicable security controls/assurance overlays)

The Process

Monitor (M):

This section discusses guidance for monitoring or continuous monitoring as it applies to SCRM.

- Review the various guidance and controls schema for potential use in a continuous monitoring program.
  - The guidance and controls need to either be repeatable and/or automated for continuous monitoring.

Note: This section may be a phase one view of continuous monitoring - can evolve and expand as SCRM approaches a more mature state.

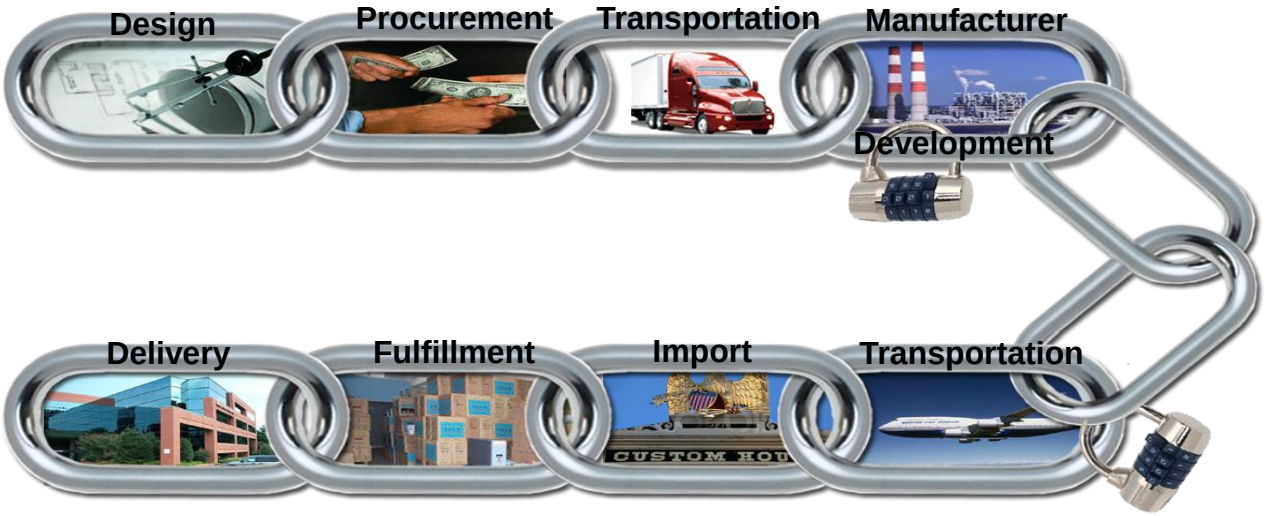
The Open Group Trusted Technology Forum (OTTF) Protecting the Technology Supply Chain

Risks – Focusing on Tainted and Counterfeit Products

Component Suppliers

(within) Vendor

Partners



…pose a threat to the end-to-end product manufacturing / development <u>process</u>

THE Open GROUP

O-TTPS Snapshot – Mitigating Risks for Tainted and Counterfeit Products

- *A tainted product* is "produced by the provider and is acquired through reputable channels but has been tampered with maliciously". - Could result in:
  - product failure, degraded performance, weakened security mechanisms allowing rogue functionality and potentially critical damage
- *A counterfeit product* is "produced other than by or for the provider, or is supplied by other than a reputable channel, and is represented as legitimate". – Could result in:
  - For customers: if product fails at critical juncture – loss of productivity, revenue
  - For providers: loss of revenue stream and brand damage

* NOTE: Malware & exploitable weaknesses could be introduced via poor manufacturing controls/practices (but not according to this definition); -- Malicious intent difficult to prove

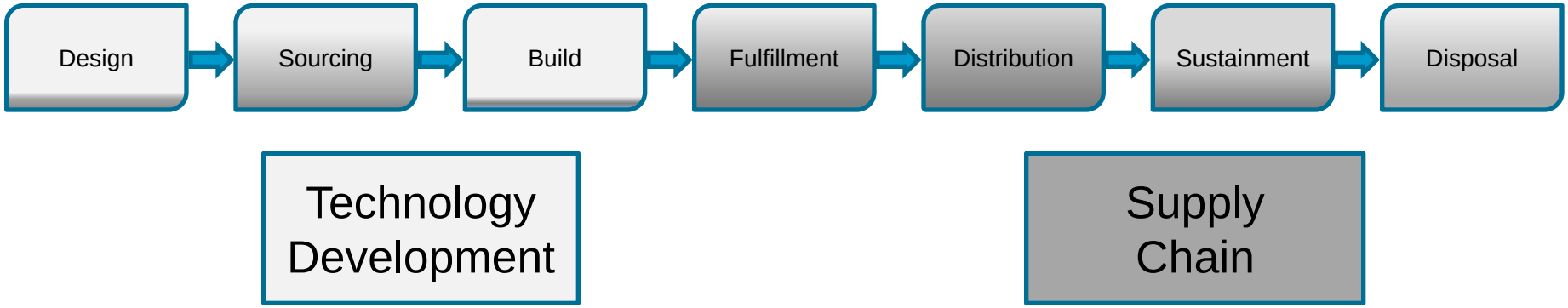
Technology Supply Chain Threat Matrix

	Taint			Counterfeit		
	Upstream	Provider	Downstream	Upstream	Provider	Downstream
Malware	✓	✓	✓			
Malicious code (masquerading as vulnerabilities)	✓	✓	✓			
Unauthorized "Parts"	✓	✓	✓	✓		
Unauthorized Configuration			✓			
Scrap/ Substandard Parts				✓		
Unauthorized Production				✓		✓

THE Open GROUP

O-TTPS Snapshot

- The Standard/Snapshot – released March 9, 2012 – a set of prescriptive requirements and recommendations for organizational best practices
- Apply across product life cycle. Some highly correlated to threats of taint and counterfeit - others more foundational but considered essential.



- 2 areas of requirements – that often overlap depending on product and provider:
  - Technology Development *mostly* under the provider's in-house supervision
  - Supply Chain activities *mostly* where provider interacts with third parties who contribute their piece in the product's life cycle

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O-TTPS: Technology Development Activities

- Product Development/Engineering Requirements in:
  - Software/Firmware/Hardware Design Process
  - Development/Engineering Process and Practices
  - Configuration Management
  - Quality/Test Management
  - Product Sustainment Management
- Secure Development/Engineering Requirements in:
  - Threat Analysis and Mitigation
  - Run-time Protection Techniques
  - Vulnerability Analysis and Response
  - Product Patching and Remediation
  - Secure Engineering Practices
  - Monitor and assess the impact of changes in the threat landscape.

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O-TTPS: Supply Chain Activities

- Supply Chain Requirements In:
  - Risk Management
  - Physical Security
  - Access Controls
  - Employee and Supplier Security
  - Business Partner Security
  - Supply Chain Security Training
  - Information Systems Security
  - Trusted Technology Components
  - Secure Transmission and Handling
  - Open Source Handling
  - Counterfeit Mitigation
  - Malware Detection

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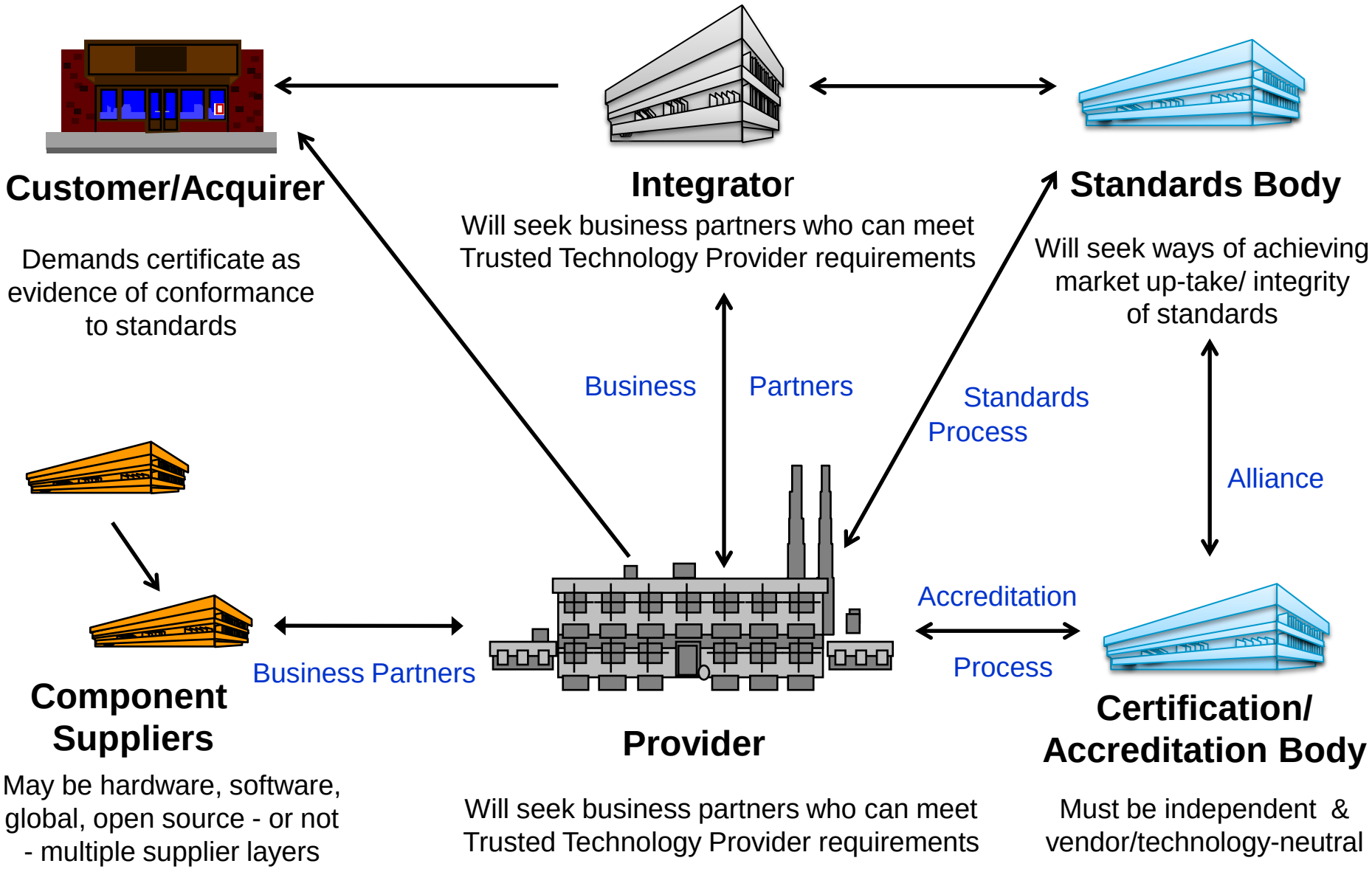

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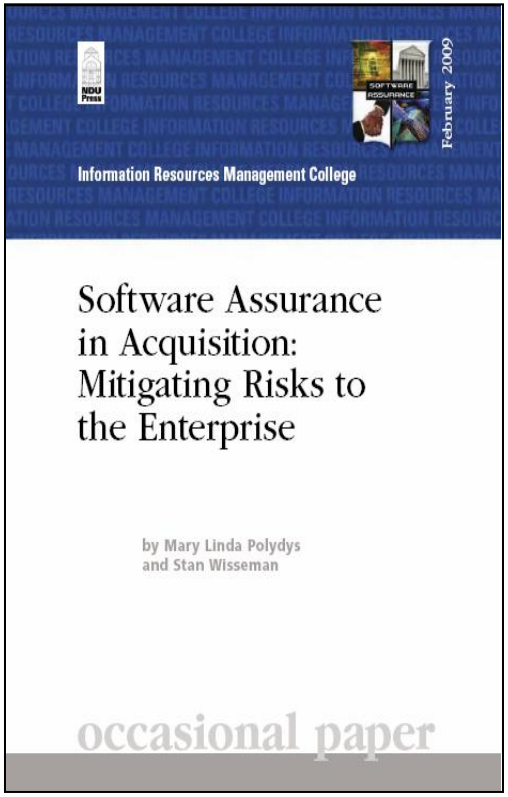
SwA Acquisition & Outsourcing Handbook

"Software Assurance in Acquisition:

Mitigating Risks to the Enterprise"

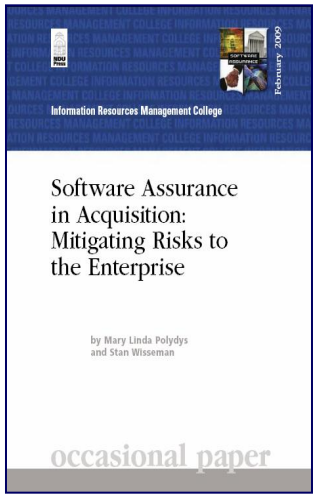
Version 1.0, Oct 2008, available for community use;

published by National Defense University Press, Feb 2009



1. Insert and enforce software assurance requirements in contracts.
2. Determine how much risk the organization can afford and who is accountable for that risk.

SwA Acquisition & Outsourcing



Software Supply Chain Risk Management and Due-Diligence -- Table 1 –SwA Concern Categories		
SwA Concern Categories	**Risks**	**Purpose for Questions**
Software History and Licensing		
Development Process Management		
Software Security Training and Awareness		
Planning and Requirements		
Architecture and Design		
Software Development		
Built-in Software Defenses		
Component Assembly		
Testing		
Software Manufacture and Packaging		
Installation		
Assurance Claims and Evidence		
Support		
Software Change Management		
Timeliness of Vulnerability Mitigation		
Individual Malicious Behavior		
Security "Track Record"		
Financial History and Status		
Organizational History		
Foreign Interests and Influences		
Service Confidentiality Policies		
Operating Environment for Services		
Security Services and Monitoring		

Table 2- Questions for COTS (Proprietary & Open Source), GOTS, and Custom Software					
No.	Question	COTS Propri-etary	COTS Open-Source	GOTS	Custom
11	Does the license/contract restrict the licensee from discovering flaws or disclosing details about software defects or weaknesses with others (e.g., is there a “gag rule” or limits on sharing information about discovered flaws)?	✓			✓
12	Does the license/contract restrict communications or limit the licensee in any potential communication with third-party advisors about provisions for support (e.g., is there a “gag rule” or limits placed on the licensee that affect ability to discuss contractual terms or breaches) regarding the licensed or contracted product or service?	✓			✓
13	Does software have a positive reputation? Does software have a positive reputation relative to security? Are there reviews that recommend it?	✓	✓		
14	Is the level of security where the software was developed the same as where the software will operate?			✓	✓
Development Process Management					
15	What are the processes (e.g., ISO 9000, CMMI, etc.), methods, tools (e.g., IDEs, compilers), techniques, etc. used to produce and transform the software (brief summary response)?	✓		✓	✓
16	What security measurement practices and data does the company use to assist product planning?	✓			✓
17	Is software assurance considered in all phases of development? Explain.	✓		✓	✓
18	How is software risk managed? Are anticipated threats identified, assessed, and prioritized?	✓		✓	✓

Table 1 –SwA Concern Categories -- (with interests relevant to security and privacy)		
SwA Concern Categories	**Risks**	**Purpose for Questions**
Service Confidentiality Policies	Without policies to enforce client data confidentiality/ privacy, acquirer's data could be at risk without service supplier liability.	To determine the service provider's confidentiality and privacy policies and ensure their enforcement.

Table 3 - Questions for Hosted Applications	
No.	Questions
Service Confidentiality Policies	
1	What are the customer confidentiality policies? How are they enforced?
2	What are the customer privacy policies? How are they enforced?
3	What are the policies and procedures used to protect sensitive information from unauthorized access? How are the policies enforced?
4	What are the set of controls to ensure separation of data and security information between different customers that are physically located in the same data center? On the same host server?
Operating Environment for Services	
5	Who configures and deploys the servers? Are the configuration procedures available for review, including documentation for all registry settings?
7	What are the data backup policies and procedures? How frequently are the backup procedures verified?
11	What are the agents or scripts executing on servers of hosted applications? Are there procedures for reviewing the security of these scripts or agents?
12	What are the procedures and policies used to approve, grant, monitor and revoke access to the servers? Are audit logs maintained?
13	What are the procedures and policies for handling and destroying sensitive data on electronic and printed media?
15	What are the procedures used to approve, grant, monitor, and revoke file permissions for production data and executable code?

SOFTWARE ASSURANCE FORUM

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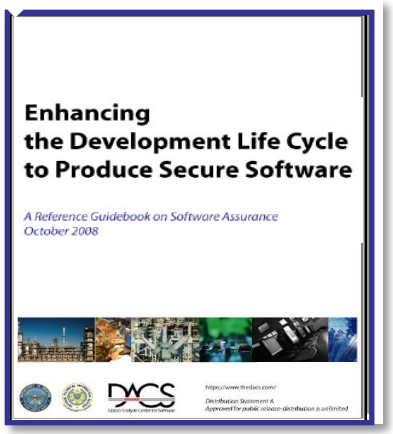
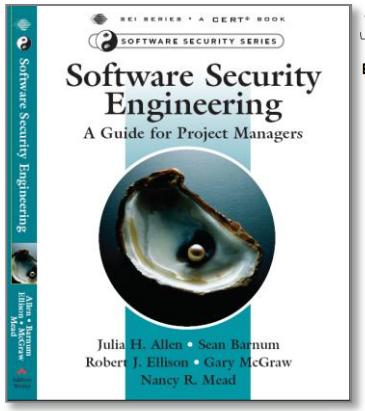
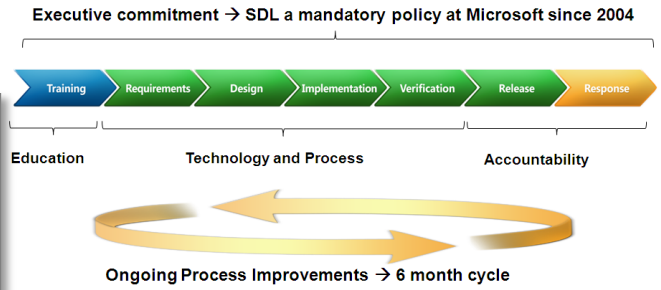
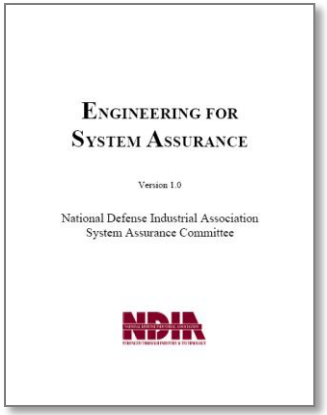
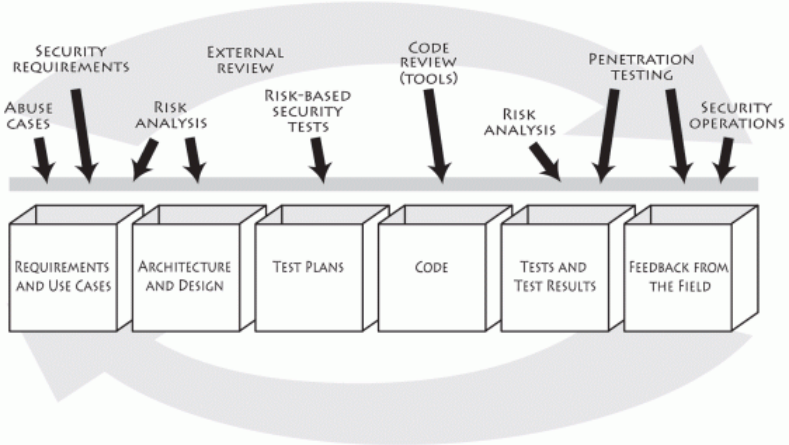
Many SwA Resources Focus On Development



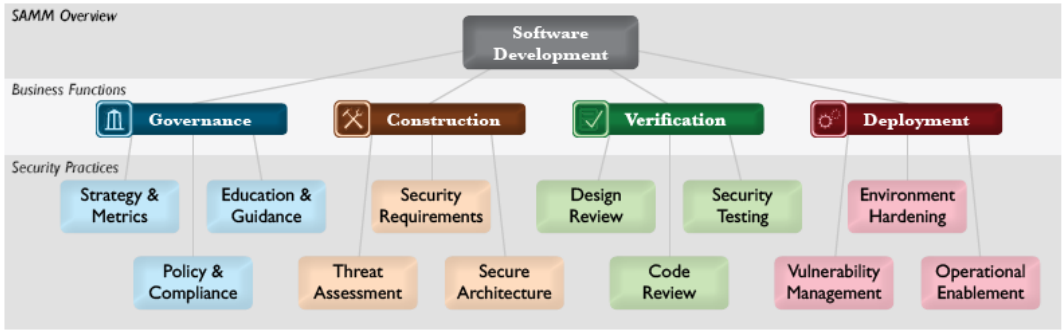








Assurance for CMMI ®

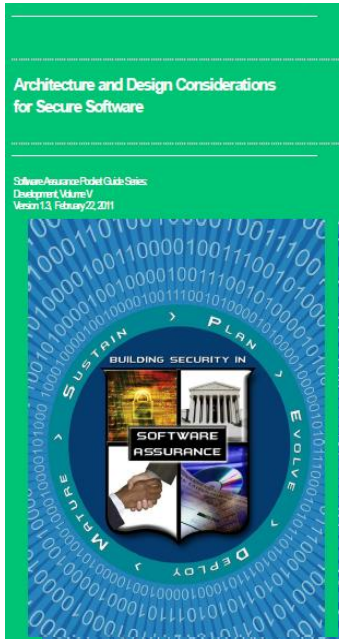


Architecture and Design Considerations for Secure Software – SwA Pocket Guide*

The IEEE Guide to the Software Engineering Body of Knowledge (SWEBOK) defines the design phase as both "the process of defining the architecture, components, interfaces, and other characteristics of a system or component" and "the result of [that] process." The software design phase:

- is the software engineering life cycle activity where software requirements are analyzed in order to produce a description of the software's internal structure that will serve as the basis for its implementation.
- consists of the architectural design and detailed design activities that follow the software requirements analysis phase and precedes software implementation in the SDLC .

- This pocket guide includes the following topics:
  - Basic Concepts
  - Design Principles for Secure Software
  - Architecture and Threat Modeling
  - Secure Design Patterns
    - Architectural-level Patterns
    - Design-level Patterns
  - Secure Session Management
  - Design and Architectural Considerations for Mobile Applications
  - Formal Methods and Architectural Design
  - Design Review and Verification
  - Key Architecture and Design Practices for Mitigating Exploitable Software Weaknesses
  - Questions to Ask Developers



*Download FREE SwA Pocket Guides at https://buildsecurityin.us-cert.gov/swa

Apply Key Principles & Practices

Table 1- Adapted from "Enhancing the Development Life Cycle to Produce Secure Software"

General Principle	Key Practices	Principle Design Conformance
Minimize the number of high-consequence targets	Principle of least privilege	Minimizes the number of actors in the system granted high levels of privilege, and the amount of time any actor holds onto its privileges.
	Separation of privileges, duties, and roles	Ensures that no single entity (human or software) should have all the privileges required to modify, delete, or destroy the system, components and resources.
	Separation of domains	This practice makes separation of roles and privileges easier to implement.
Don't expose vulnerable or high-consequence components	Keep program data, executables, and configuration data separated	Reduces the likelihood that an attacker who gains access to program data will easily locate and gain access to program executables or control/configuration data.
	Segregate trusted entities from untrusted entities	Reduces the exposure of the software's high-consequence functions from its high-risk functions, which can be susceptible to attacks.
	Minimize the number of entry and exit points	Reduces the attack surface.
	Assume environment data is not trustworthy	Reduces the exposure of the software to potentially malicious execution environment components or attacker-intercepted and modified environment data.
	Use only trusted interfaces to environment resources	This practice reduces the exposure of the data passed between the software and its environment.
Deny attackers the means to compromise	Simplify the design	This practice minimizes the number of attacker-exploitable vulnerabilities and weaknesses in the system.
	Hold ***all*** actors accountable	This practice ensures that all attacker actions are observed and recorded, contributing to the ability to recognize and isolate/block the source of attack patterns.
	Timing, synchronization, and sequencing should be simplified to avoid issues.	Modeling and documenting timing, synchronization, and sequencing issues will reduce the likelihood of race conditions, order dependencies, synchronization problems, and deadlocks.
	Make secure states easy to enter and vulnerable states difficult to enter	This practice reduces the likelihood that the software will be allowed to inadvertently enter a vulnerable state.
	Design for controllability	This practice makes it easier to detect attack paths, and disengage the software from its interactions with attackers. Caution should be taken when using this approach since it can open a whole range of new attack vectors.
	Design for secure failure	Reduces the likelihood that a failure in the software will leave it vulnerable to attack.

Leverage Attack Patterns

CAPEC – Common Attack Pattern Enumeration and Classification: *capec.mitre.org*

Attack Patterns:

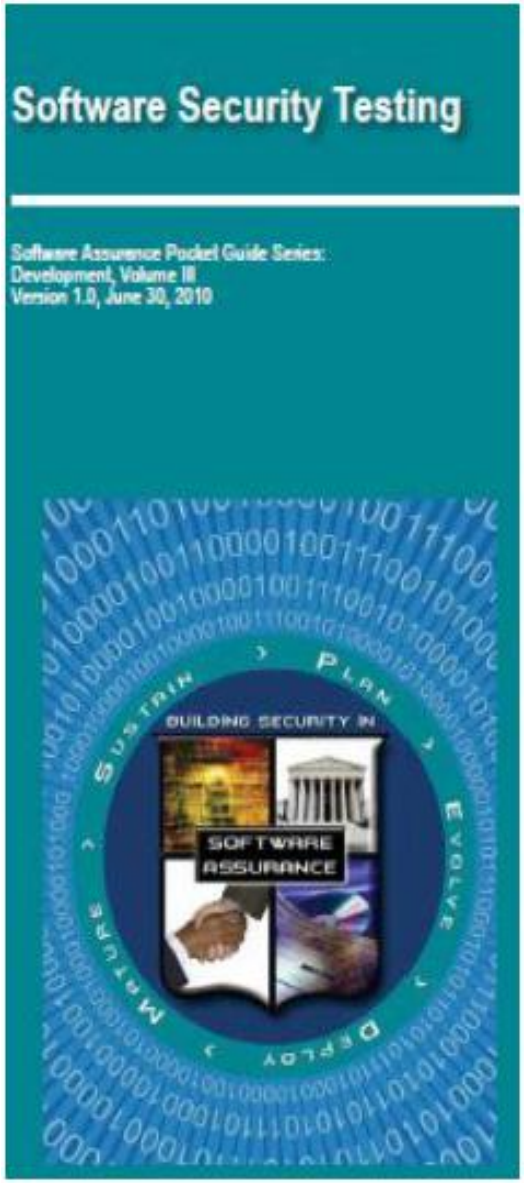
- Blueprint for creating a specific type of attack
- Abstracted common attack approaches from the set of known exploits
- Capture the attacker's perspective to aid software developers, acquirers and operators in improving the assurance profile of their software

Use Attack Patterns to:

- Guide definition of appropriate policies
- Guide creation of appropriate security requirements (positive and negative)
- Provide context for architectural risk analysis
- Guide risk-driven secure code review
- Provide context for appropriate security testing
- Provide a bridge between secure development and secure operations

Software Security Testing –vs– Security Requirements Testing

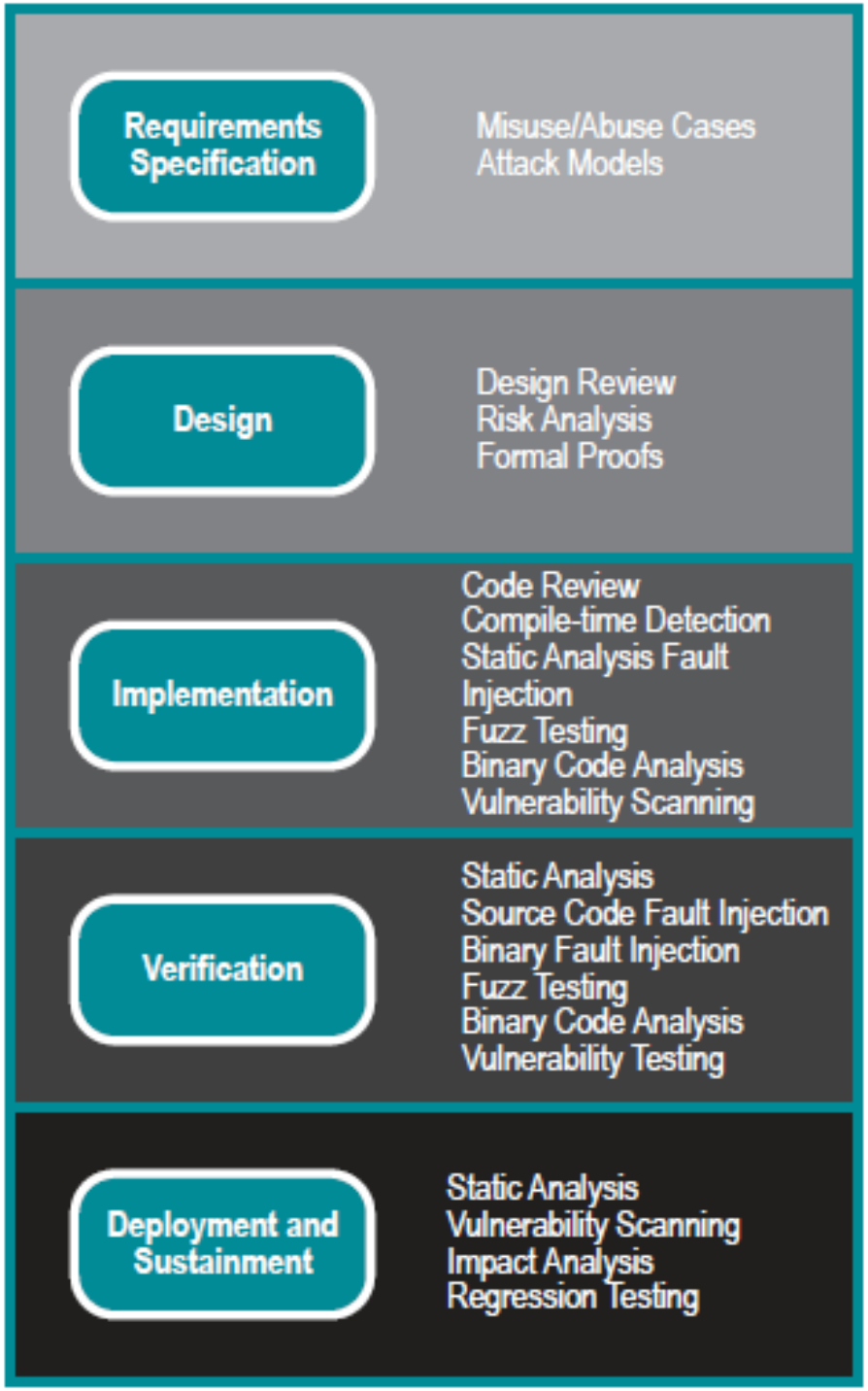
- Software security testing is not the same as testing the correctness and adequacy of security functions implemented by software, which are most often verified through requirements-based testing that:
  - cannot fully demonstrate that software is free from exploitable weaknesses / vulnerabilities.
  - is not the best approach to determining how software will behave under anomalous and hostile conditions.
- Download FREE SwA Pocket Guide on Software Security Testing at https://buildsecurityin.us-cert.gov/swa



Homeland Security

Software Security Test Techniques throughout SDLC

See details in FREE SwA Pocket Guide on Software Security Testing at https://buildsecurityin.us-cert.gov/swa

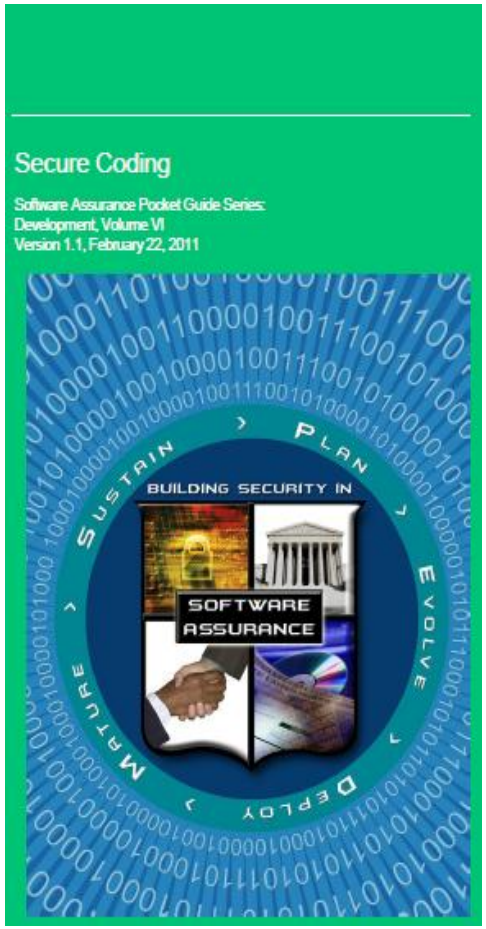


Penetration Testing can enhance pre-deployment test outcomes and identify post-release exploit points

Homeland Security

Secure Coding

- Preparing to Write Secure Code
- Secure Coding Principles
- Secure Coding Practices
- Secure Memory and Cache Management
- Secure Error and Exception Handling
- What to Avoid
- Questions to Ask Developers



Are any compiler warnings disabled in code being delivered?

Homeland Security

Key Practices for Mitigating the Most Egregious Exploitable Software Weaknesses

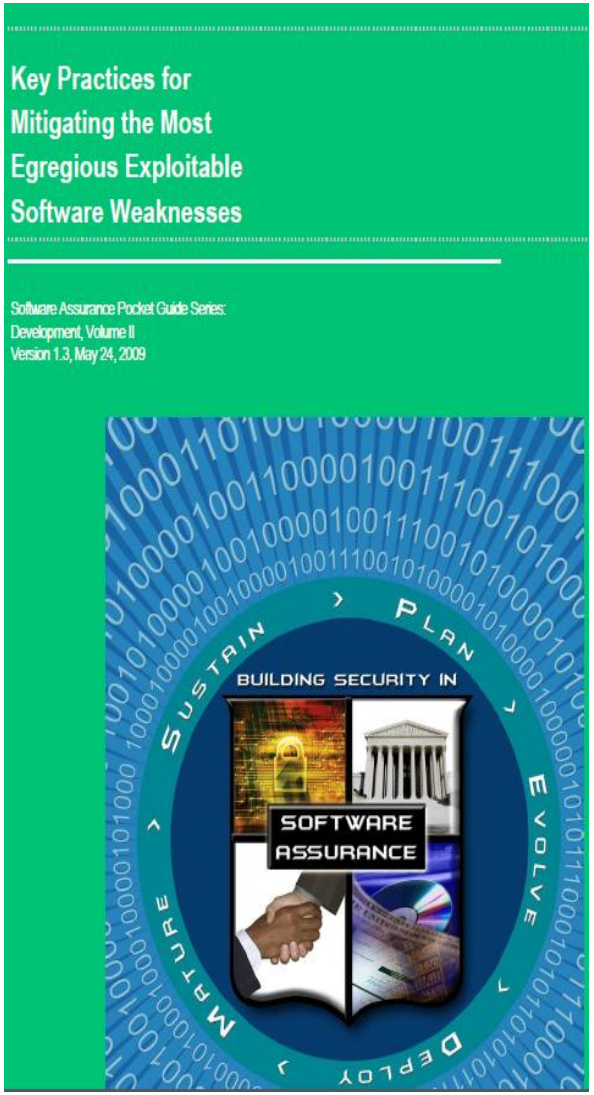
- *Identifies mission/business risks attributable to the respective weaknesses; identifies common attacks that exploit those weaknesses, and provides recommended practices for preventing the weaknesses.*

- CWE focuses on stopping vulnerabilities at the source by educating designers, programmers, and QA/testers on how to eliminate all too-common mistakes before software is even shipped.

- CWE Top-N lists serve as tools for education, training and awareness to help programmers prevent the kinds of vulnerabilities that plague the software industry.

- Software consumers could use the same list to help them to ask for more secure software.

- Software managers and CIOs can use the CWE list as a measuring stick of progress in their efforts to secure their software.



https://buildsecurityin.us-cert.gov/swa/downloads/KeyPracticesMWV13_02AM091111.pdf

SOFTWARE ASSURANCE FORUM

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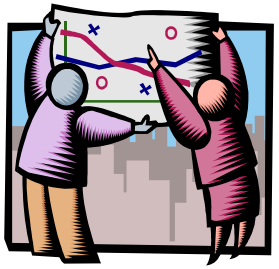
Process Improvement Lifecycle - A Process for Achieving Assurance

Mission/Business Process

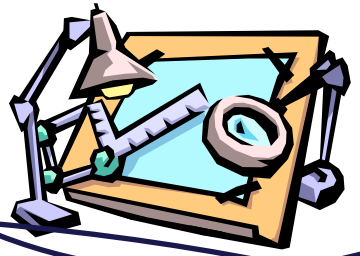
Understand Your Business Requirements for Assurance



Measure Your Results

Information System

Build or Refine and Execute Your Assurance Processes



Understand Assurance-Related Process Capability Expectations

Organization Support

Look to Standards for Assurance Process Detail

Adapted from: Paul Croll, Computer Sciences Corporation, August 2007

SOFTWARE ASSURANCE FORUM

BUILDING SECURITY IN

Assurance Process Reference Model

Define Business Goals

Development Project

DP 1 Identify and manage risks due to vulnerabilities throughout the product and system lifecycle

DP 2 Establish and maintain assurance support from the project

DP 3 Protect project and organizational assets

Enterprise Assurance Support

ES 1 Establish and maintain organizational culture where assurance is an integral part of achieving the mission

ES 2 Establish and maintain the ability to support continued delivery of assurance capabilities

ES 3 Monitor and improve enterprise support to IT assets

Development Organization

DO 1 Establish the assurance resources to achieve key business objectives

DO 2 Establish the environment to sustain the assurance program within the organization

Prioritize funds and manage risks

Acquisition and Supplier Management

AM 1 Select, manage, and use effective suppliers and third party applications based upon their assurance capabilities.

Development Engineering

DE 1 Establish assurance requirements

DE 2 Create IT solutions with integrated business objectives and assurance

DE 3 Verify and Validate an implementation for assurance

Enable Resilient Technology

Sustained environment to achieve business goals through technology

Created to facilitate Communication Across An Organization's Multi-Disciplinary Stakeholders

Courtesy of Michele Moss, BAH, SwA Processes & Practices

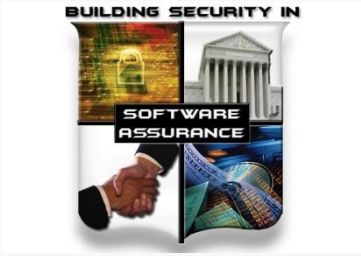
https://buildsecurityin.us-cert.gov/swa/proself_assm.html

Security Measurement Resources

Oct 08 → Feb 09 → May 09 →

Practical Measurement Framework for Software Assurance and Information Security

Oct 2008



The Center for Internet Security

The CIS Security Metrics

February 9

2009

Organizations struggle to make cost-effective security investment decisions; information security professionals lack widely accepted and unambiguous metrics for decision support. CIS established a consensus team of one hundred (100) industry experts to address this need. The result is a set of standard metric and data definitions that can be used across organizations to collect and analyze data on security process performance and outcomes.

This document contains twenty-one (21) metric definitions for six (6) important business functions: Incident Management, Vulnerability Management, Patch Management, Application Security, Configuration Management and Financial Metrics. Additional consensus metrics are currently being defined for these and additional business functions.

Consensus Metric Definitions

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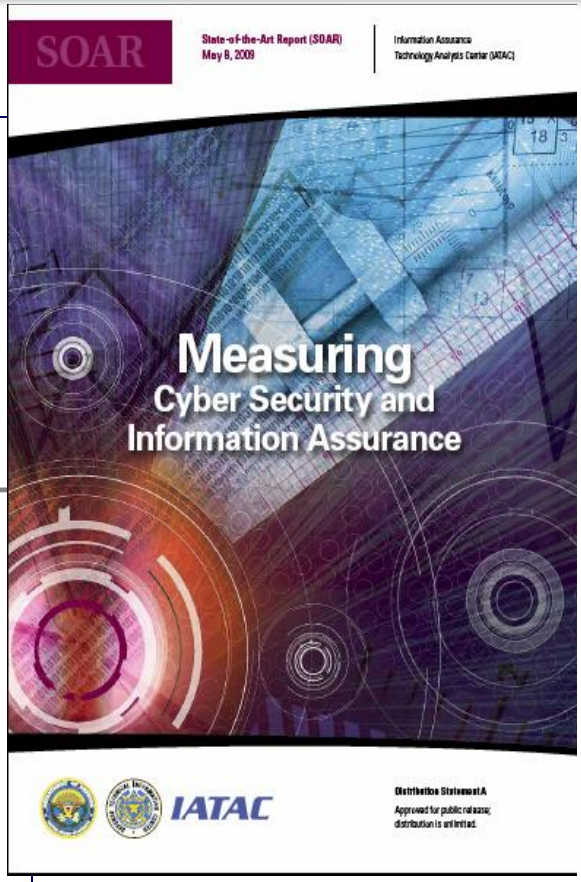
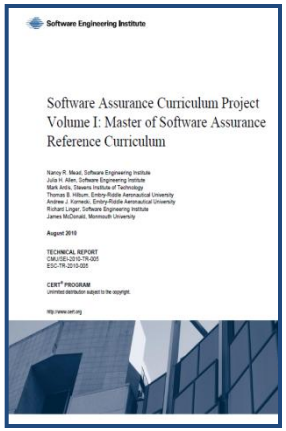


Software Assurance Curriculum Project

- **Vol I: Master of Software Assurance Reference Curriculum**

In Dec 2010 the IEEE Computer Society and the ACM recognized the Master of Software Assurance (MSwA) Reference Curriculum as a certified master's degree program in SwA —the first curriculum to focus on assuring the functionality, dependability, and security of software and systems.


Software Engineering Institute

Software Assurance Curriculum Project
Volume I: Master of Software Assurance Reference Curriculum

Nancy R. Mead, Software Engineering Institute
Julia H. Allen, Software Engineering Institute
Mark Ardis, Stevens Institute of Technology
Thomas B. Hilburn, Embry-Riddle Aeronautical University
Andrew J. Kornecki, Embry-Riddle Aeronautical University
Richard Linger, Software Engineering Institute
James McDonald, Monmouth University

August 2010

TECHNICAL REPORT
CMU/SEI-2010-TR-005
ESC-TR-2010-005

CERT® PROGRAM
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- **Vol II: SwA Undergraduate Course Outlines**

see www.sei.cmu.edu/library/abstracts/reports/10tr019.cfm to download the PDF version of the report CMU/SEI-2010-TR-019

- **Vol III: Master of SwA Course Syllabi**
- **Vol IV: Community College Education**

• Report on "Integrating the MSwA Reference Curriculum into Model Curriculum and Guidelines for Graduate Degree Programs in Information Systems" provides reference and guidance material.

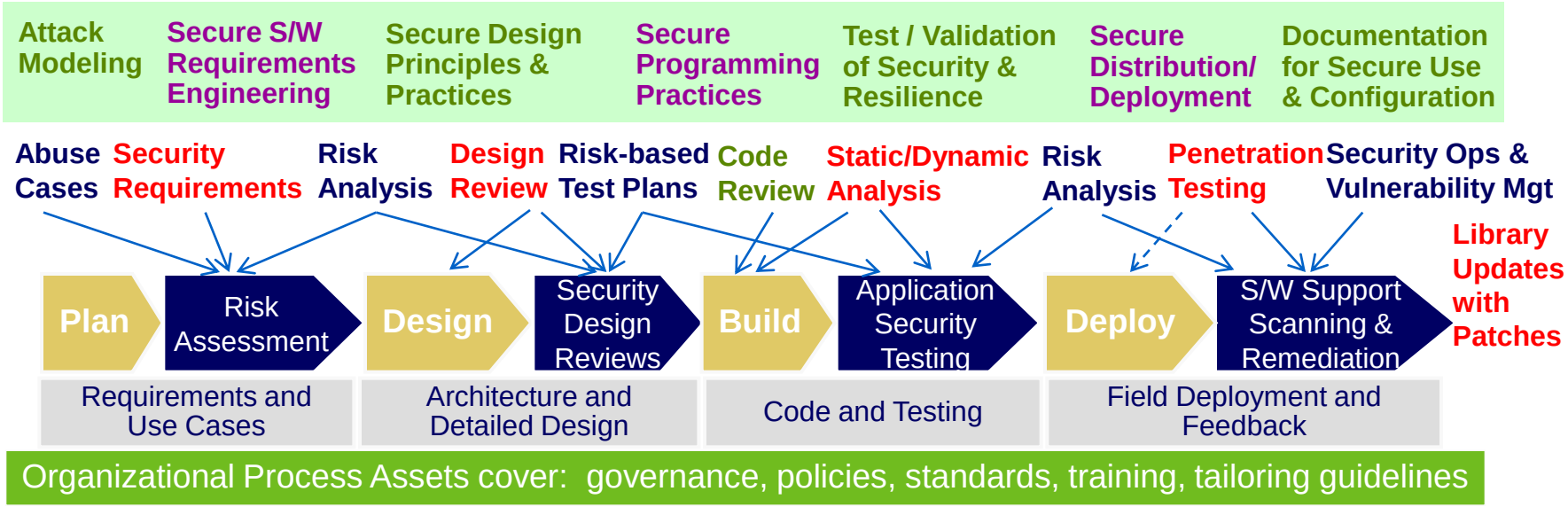
•To facilitate implementation, the MSwA project team is offering assistance, free of charge, to educational institutions looking to launch an MSwA degree program.

• For more information,go to https://buildsecurityin.us-cert.gov/bsi/1165-BSI.html.

Security-Enhanced Process Improvements

Organizations that provide security engineering & risk-based analysis throughout the lifecycle will have more resilient software products / systems.

"Build Security In" throughout the lifecycle



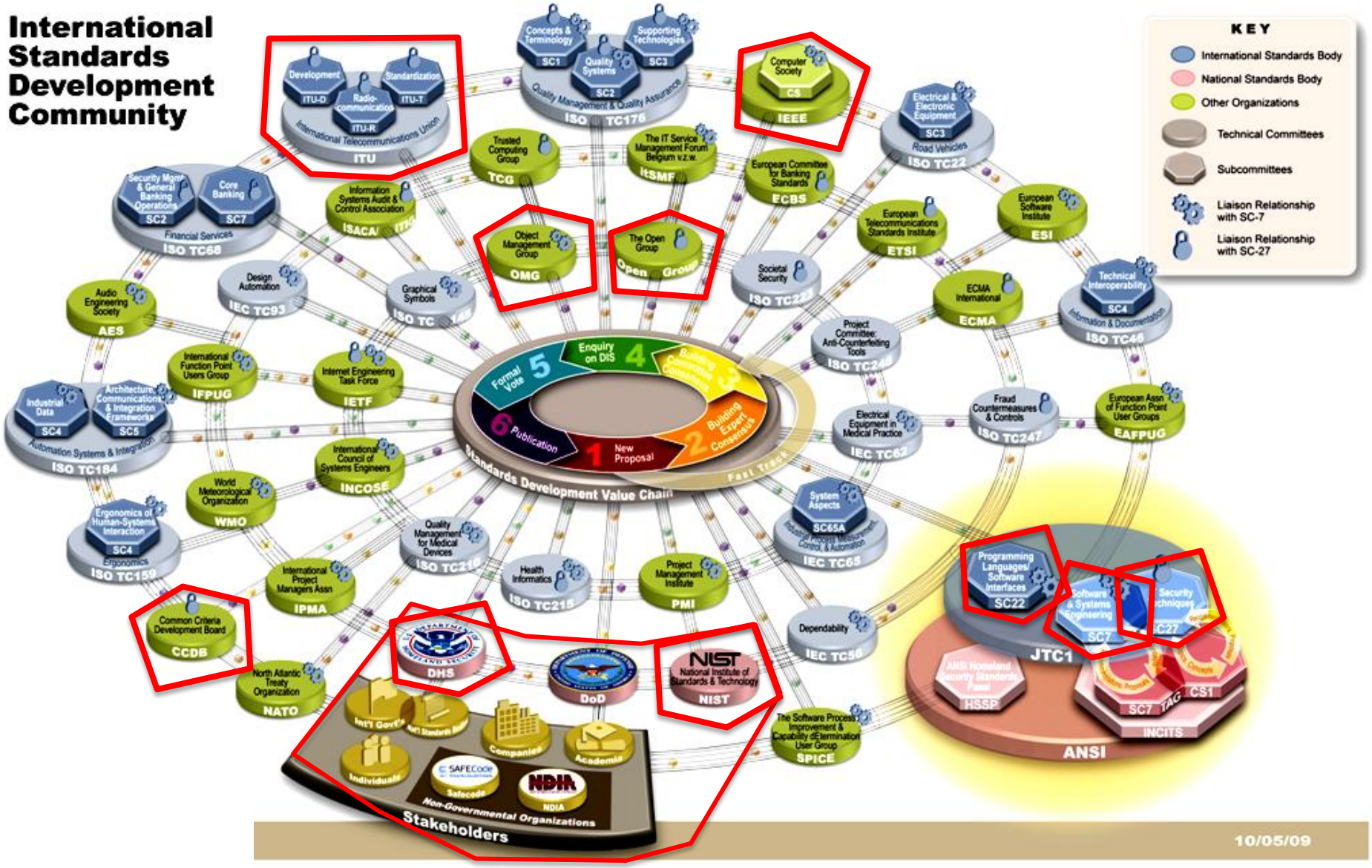
Organizational Process Assets cover: governance, policies, standards, training, tailoring guidelines

- Leverage Software Assurance resources (freely available) to incorporate in training & awareness
- Modify SDLC to incorporate security processes and tools (should be done in phases by practitioners to determine best integration points)
- Avoid drastic changes to existing development environment and allow for time to change culture and processes
- Make the business case and balance the benefits
- Retain upper management sponsorship and commitment to producing secure software.

Homeland Security

* Adopted in part from "Software Assurance: Mitigating Supply Chain Risks" (DHS NCSD SwA); "What to Test from a Security Perspective for the QA Professional" (Cigital) and "Neutralizing the Threat: A Case Study in Enterprise-wide Application Security Deployments" (HP Fortify Software & Accenture Security Technology Consulting)

We are engaged with many parts of the Community for Software Assurance-related standardization



ISO/IEC JTC1

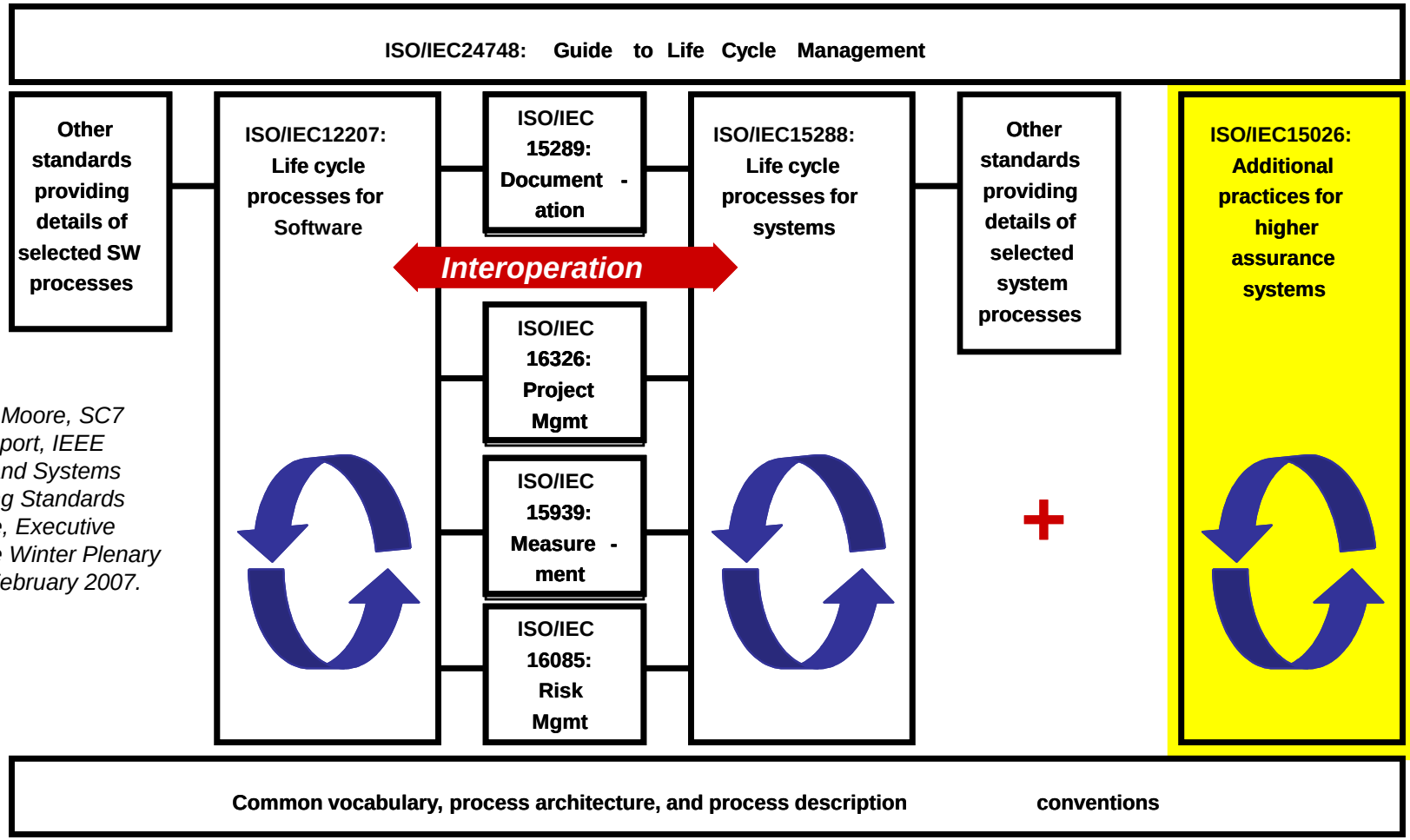
- **ISO/IEC 27036—IT Security Techniques—Supplier Relationships**
  - Techniques between acquirer and supplier for supply chain risk management

- **SC22: ISO/IEC Technical Report (TR) 24772 Information technology -- Programming languages -- Guidance to avoiding vulnerabilities in programming languages through language selection and use.**
  - Published in October 2010.
  - As published, the document includes language-independent summaries of nearly 70 classes of vulnerabilities.
  - The working group is already drafting the 2nd Edition of the report which will add information specific to individual programming languages.

Use recent versions of compilers and
DO NOT disable compiler warning flags

- **SC7: ISO/IEC 15026, System and Software Assurance**
  - Publication of the standard, by both ISO/IEC and IEEE, in spring 2011.

ISO/IEC/IEEE 15026, System and Software Assurance



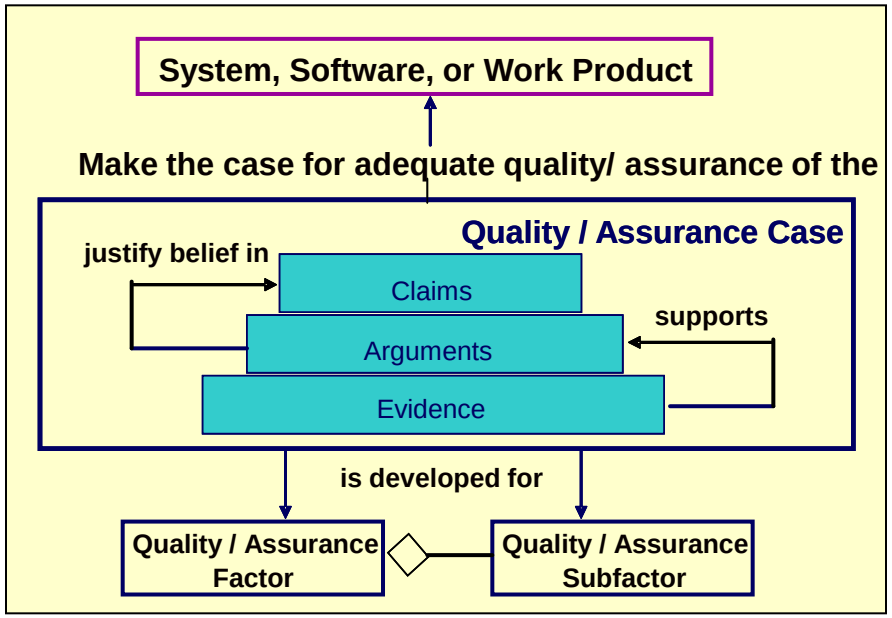
Source: J. Moore, SC7 Liaison Report, IEEE Software and Systems Engineering Standards Committee, Executive Committee Winter Plenary Meeting, February 2007.

"System and software assurance focuses on the management of risk and assurance of safety, security, and dependability within the context of system and software life cycle

Terms of Reference changed: ISO/IEC JTC1/SC7 WG7, previously "System and Software Integrity" SC7 WG9

ISO/IEC/IEEE 15026 Assurance Case

- **Set of structured assurance claims, supported by evidence and reasoning (arguments), that demonstrates how assurance needs have been satisfied.**
  - Shows compliance with assurance objectives
  - Provides an argument for the safety and security of the product or service.
  - Built, collected, and maintained throughout the life cycle
  - Derived from multiple sources



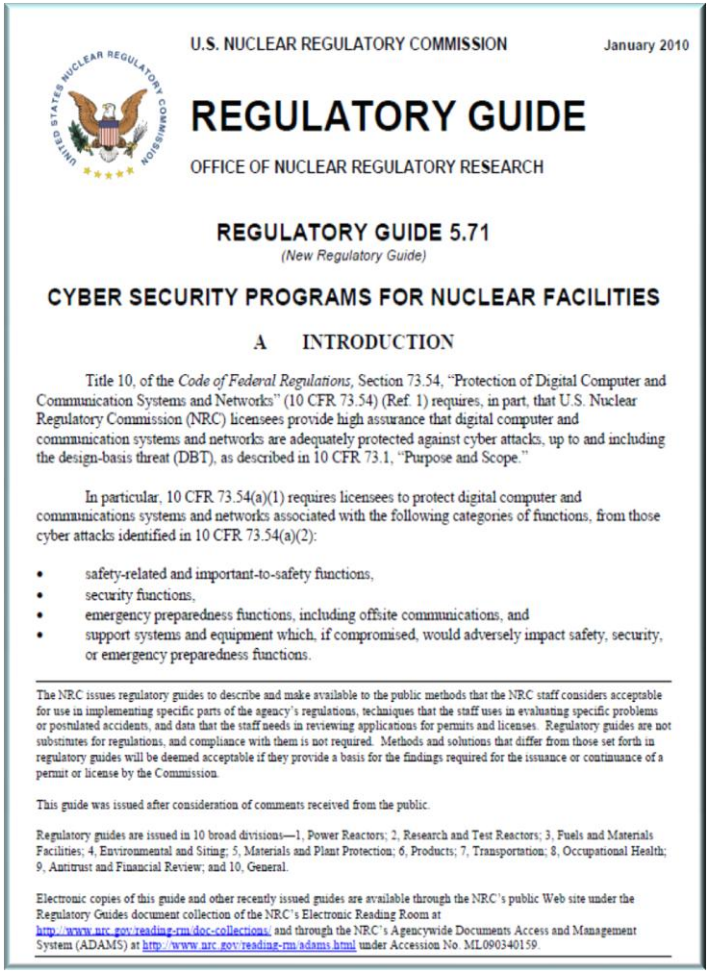
- **Sub-parts**
  - A high level summary
  - Justification that product or service is acceptably safe, secure, or dependable
  - Rationale for claiming a specified level of safety and security
  - Conformance with relevant standards & regulatory requirements
  - The configuration baseline
  - Identified hazards and threats and residual risk of each hazard / threat
  - Operational & support assumptions

Attributes

- Clear
- Consistent
- Complete
- Comprehensible
- Defensible
- Bounded
- Addresses all life cycle stages

NRC Regulatory Guidance on Cyber Security

- NRC Regulatory Guide 5.71, “Cyber Security Programs for Nuclear Facilities,” Section C.12 in Appendix C, “System and Service Acquisition”
  - Directly relates to current NRC guidance on cyber security in the supply chain and SDLC of an ICS regulated by the agency.
  - Section C.12.2 “Supply Chain Protection” control drill down to the vendor level with requirements accountability for the RG 5.71 control baseline (Appendices B&C).
  - Section C.12.3 “Trustworthiness” requires developers employ software quality and validation methods to minimize flawed or malformed software; requires all tools to undergo commercial certification process
  - Section C.12.5 “Developer Security Testing”



U.S. NUCLEAR REGULATORY COMMISSION January 2010

REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

REGULATORY GUIDE 5.71

(New Regulatory Guide)

CYBER SECURITY PROGRAMS FOR NUCLEAR FACILITIES

A INTRODUCTION

Title 10, of the *Code of Federal Regulations*, Section 73.54, “Protection of Digital Computer and Communication Systems and Networks” (10 CFR 73.54) (Ref. 1) requires, in part, that U.S. Nuclear Regulatory Commission (NRC) licensees provide high assurance that digital computer and communication systems and networks are adequately protected against cyber attacks, up to and including the design-basis threat (DBT), as described in 10 CFR 73.1, “Purpose and Scope.”

In particular, 10 CFR 73.54(a)(1) requires licensees to protect digital computer and communications systems and networks associated with the following categories of functions, from those cyber attacks identified in 10 CFR 73.54(a)(2):

- safety-related and important-to-safety functions,
- security functions,
- emergency preparedness functions, including offsite communications, and
- support systems and equipment which, if compromised, would adversely impact safety, security, or emergency preparedness functions.

The NRC issues regulatory guides to describe and make available to the public methods that the NRC staff considers acceptable for use in implementing specific parts of the agency’s regulations, techniques that the staff uses in evaluating specific problems or postulated accidents, and data that the staff needs in reviewing applications for permits and licenses. Regulatory guides are not substitutes for regulations, and compliance with them is not required. Methods and solutions that differ from those set forth in regulatory guides will be deemed acceptable if they provide a basis for the findings required for the issuance or continuance of a permit or license by the Commission.

This guide was issued after consideration of comments received from the public.

Regulatory guides are issued in 10 broad divisions—1, Power Reactors; 2, Research and Test Reactors; 3, Fuels and Materials Facilities; 4, Environmental and Siting; 5, Materials and Plant Protection; 6, Products; 7, Transportation; 8, Occupational Health; 9, Antitrust and Financial Review; and 10, General.

Electronic copies of this guide and other recently issued guides are available through the NRC’s public Web site under the Regulatory Guides document collection of the NRC’s Electronic Reading Room at http://www.nrc.gov/reading-rm/doc-collections/ and through the NRC’s Agencywide Documents Access and Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html under Accession No. ML090340159.

See NRC Regulatory Guidance on Cyber Security http://pbadupws.nrc.gov/docs/ML0903/ML090340159.pdf

Software Security Assurance: Not just a good idea

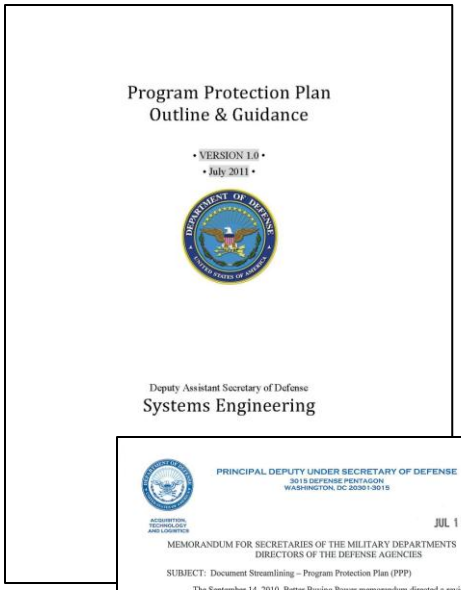
- Many people responsible for protecting most critical infrastructure facilities have felt comfortable about security of their systems.
  - Facilities rely on industrial control systems (ICS) -- custom-built suites of systems that control essential mechanical functions of power grids, processing plants, etc -- usually not connected to the Internet, also known as "air-gapped."
  - Many industry owners, operators and regulators believed that this security model provided an infallible, invulnerable barrier to malicious cyber attacks from criminals and advanced persistent threat (APT) adversaries.

- National Defense Authorization Act (NDAA) -- which included a focus on software security (in Section 932, Strategy on Computer Software Assurance) -- serves as first cybersecurity law of 2011 and requires the U.S. Dept of Defense to develop a strategy for ensuring the security of software applications.

- Software Security Assurance, a set of practices for ensuring proactive application security, is key to making applications compliant with this new law.

"How Stuxnet Demonstrates That Software Assurance Equals Mission Assurance: The rules of the game have changed," by Rob Roy, Federal CTO of Fortify, an HP Company

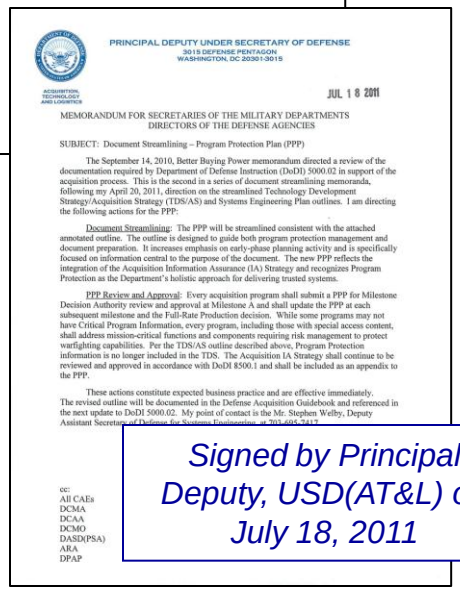
Program Protection Plan Outline and Guidance as "Expected Business Practice"



Program Protection Plan
Outline & Guidance

• VERSION 1.0 •
• July 2011 •

Deputy Assistant Secretary of Defense
Systems Engineering



PRINCIPAL DEPUTY UNDER SECRETARY OF DEFENSE
3015 DEFENSE PENTAGON
WASHINGTON, DC 20301-3015

ACQUISITION, TECHNOLOGY AND LOGISTICS

JUL 18 2011

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
DIRECTORS OF THE DEFENSE AGENCIES

SUBJECT: Document Streamlining – Program Protection Plan (PPP)

The September 14, 2010, Better Buying Power memorandum directed a review of the documentation required by Department of Defense Instruction (DoDI) 5000.02 in support of the acquisition process. This is the second in a series of document streamlining memoranda, following my April 20, 2011, direction on the streamlined Technology Development Strategy/Acquisition Strategy (TDS/AS) and Systems Engineering Plan outlines. I am directing the following actions for the PPP:

Document Streamlining: The PPP will be streamlined consistent with the attached annotated outline. The outline is designed to guide both program protection management and document preparation. It increases emphasis on early-phase planning activity and is specifically focused on information central to the purpose of the document. The new PPP reflects the integration of the Acquisition Information Assurance (IA) Strategy and recognizes Program Protection as the Department's holistic approach for delivering trusted systems.

PPP Review and Approval: Every acquisition program shall submit a PPP for Milestone Decision Authority review and approval at Milestone A and shall update the PPP at each subsequent milestone and the Full-Rate Production decision. While some programs may not have Critical Program Information, every program, including those with special access content, shall address mission-critical functions and components requiring risk management to protect warfighting capabilities. Per the TDS/AS outline described above, Program Protection information is no longer included in the TDS. The Acquisition IA Strategy shall continue to be reviewed and approved in accordance with DoDI 8500.1 and shall be included as an appendix to the PPP.

These actions constitute expected business practice and are effective immediately. The revised outline will be documented in the Defense Acquisition Guidebook and referenced in the next update to DoDI 5000.02. My point of contact is the Mr. Stephen Welby, Deputy Assistant Secretary of Defense for Systems Engineering, at 703-695-7417.

cc:
All CAEs
DCMA
DCAA
DCMO
DASD(PSA)
ARA
DPAP

Signed by Principal Deputy, USD(AT&L) on July 18, 2011

What's in the DoD Policy Memo?

- *"Every acquisition program shall submit a PPP for Milestone Decision Authority review and approval at Milestone A and shall update the PPP at each subsequent milestone and the Full-Rate Production decision."*
- Expected business practice, effective immediately, and reflected in upcoming DoDI 5000.02 and DAG updates

The PPP is the Single Focal Point for All Security Activities on the Program

http://www.acq.osd.mil/se/pg/index.html#PPP

Software Assurance Methods

Counter-measure Selection

Development Process

Apply assurance activities to the procedures and structure imposed on software development

Operational System

Implement countermeasures to the design and acquisition of end-item software products and their interfaces

Development Environment

Apply assurance activities to the environment and tools for developing, testing, and integrating software code and interfaces

Table 5.3-5-5: Application of Software Assurance Countermeasures (sample)

Development Process								
Software (CPI, critical function components, other software)	**Static Analysis p/a**	**Design Inspect**	**Code Inspect p/a**	**CVE p/a**	**CAPEC p/a**	**CWE p/a**	**Pen Test**	**Test Coverage p/a**
Developmental CPI SW	100/80%	Two Levels	100/80	100/60	100/60	100/60	Yes	75/50%
Developmental Critical Function SW	100/80%	Two Levels	100/80	100/70	100/70	100/70	Yes	75/50%
Other Developmental SW	none	One level	100/65	10/0	10/0	10/0	No	50/25%
COTS CPI and Critical Function SW	Vendor SwA	Vendor SwA	Vendor SwA	0	0	0	Yes	UNK
COTS (other than CPI and Critical Function) and NDI SW	No	No	No	0	0	0	No	UNK
Operational System								
	Failover Multiple Supplier Redundancy	**Fault Isolation**	**Least Privilege**	**System Element Isolation**		**Input checking / validation**		**SW load key**
Developmental CPI SW	30%	All	all	yes		All		All
Developmental Critical Function SW	50%	All	All	yes		All		all
Other Developmental SW	none	Partial	none	None		all		all
COTS (CPI and CF) and NDI SW	none	Partial	All	None		Wrappers/ all		all
Development Environment								
SW Product	**Source**	**Release testing**	**Generated code inspection p/a**					
C Compiler	No	Yes	50/20					
Runtime libraries	Yes	Yes	70/none					
Automated test system	No	Yes	50/none					
Configuration management system	No	Yes	NA					
Database	No	Yes	50/none					
Development Environment Access	Controlled access; Cleared personnel only							

Additional Guidance in PPP Outline and Guidance

Software Assurance

Software Assurance (SwA) is **the level of confidence that software functions as intended and is free of vulnerabilities**, either intentionally or unintentionally designed or inserted as part of the software throughout the life cycle.*

Derived From: CNSSI-4009

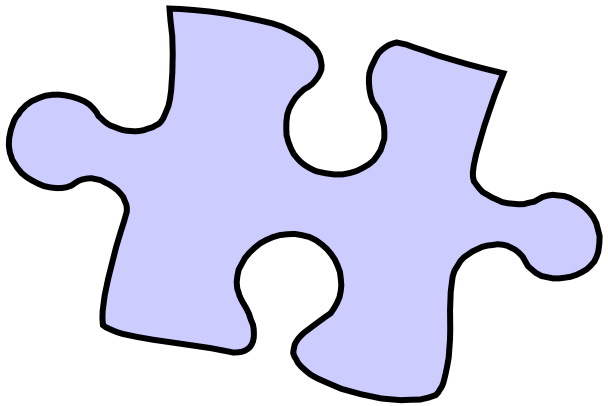
Automation

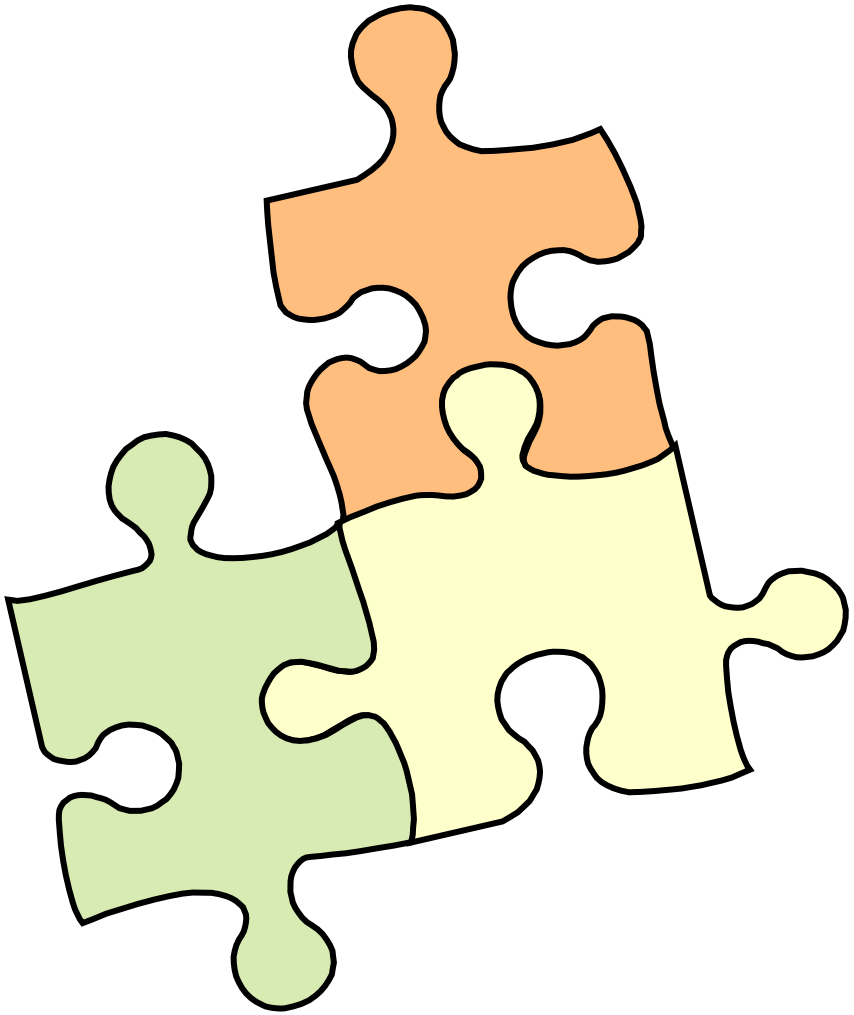
Languages, enumerations, registries, tools, and repositories

throughout the Lifecycle

Including design, coding, testing, deployment, configuration and operation

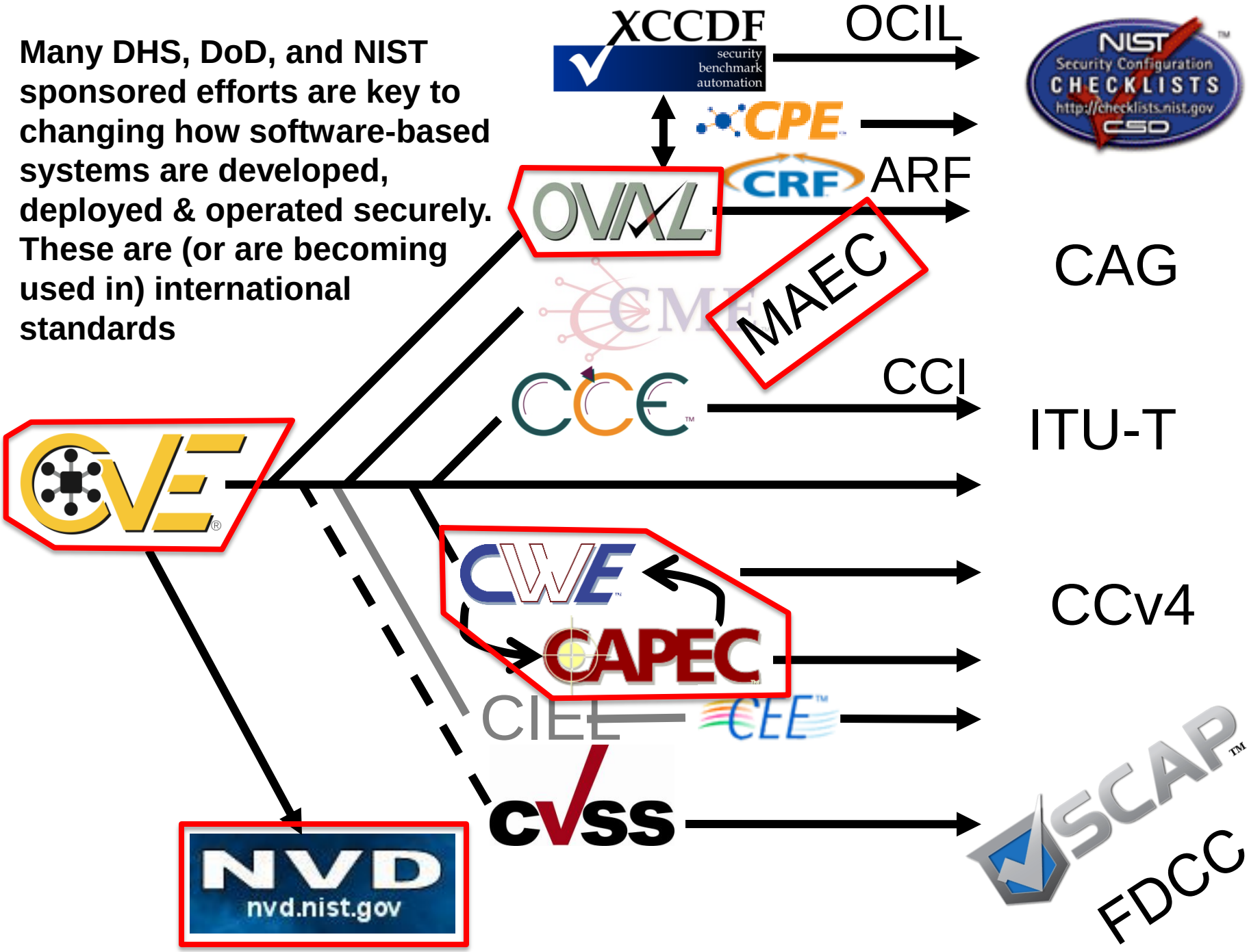
Automation is *one piece*



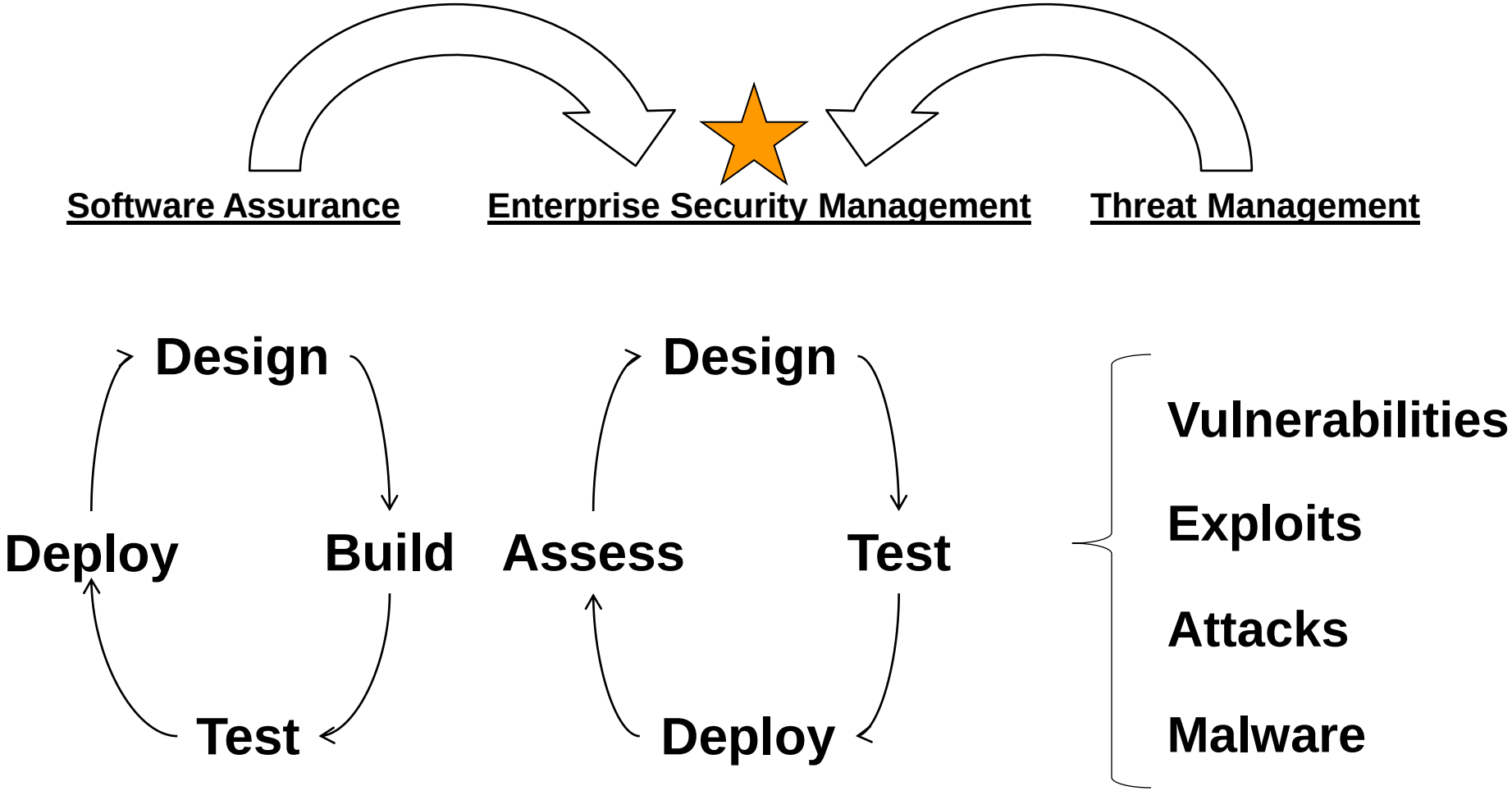


of the SwA puzzle.

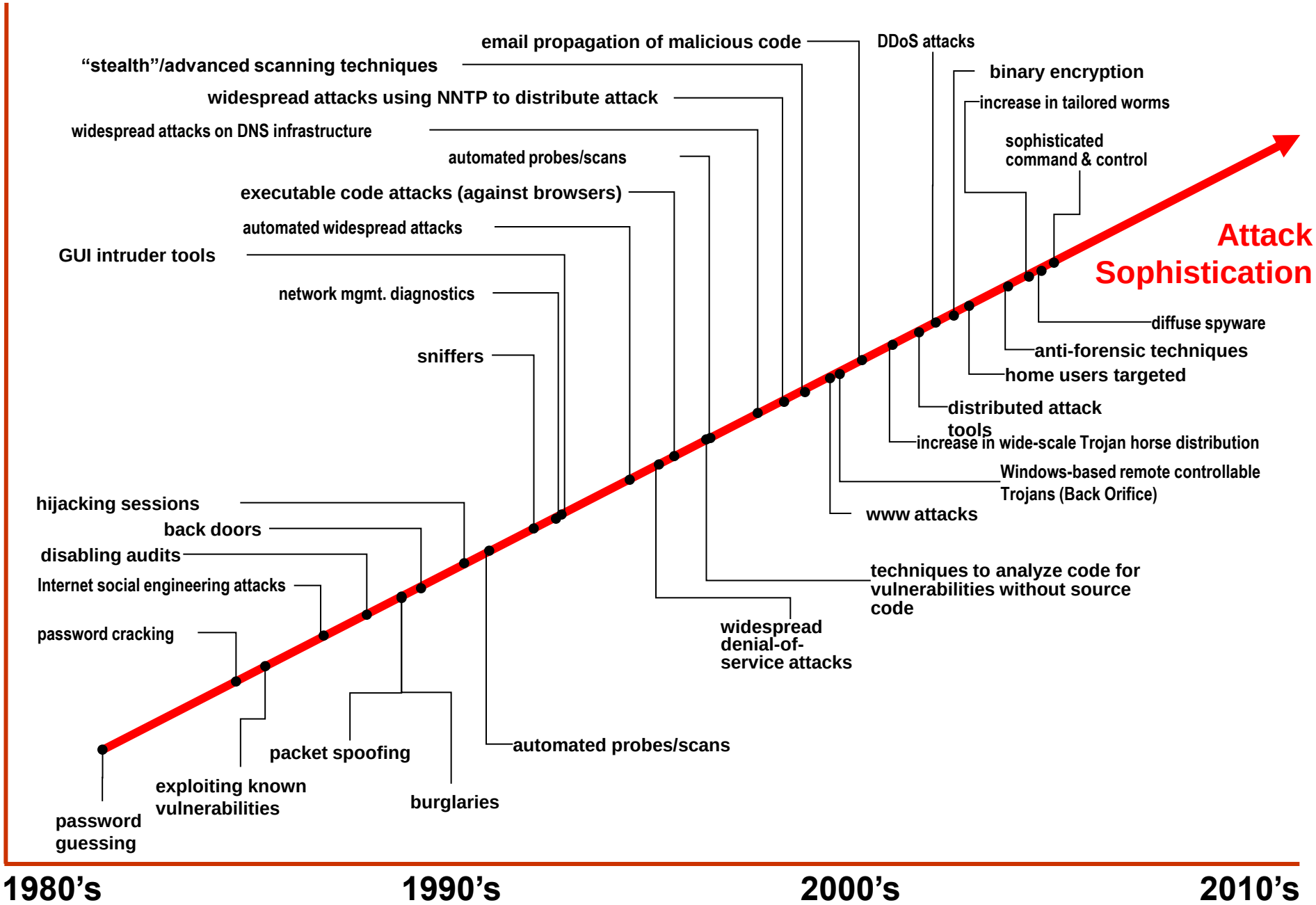
Many DHS, DoD, and NIST sponsored efforts are key to changing how software-based systems are developed, deployed & operated securely. These are (or are becoming used in) international standards



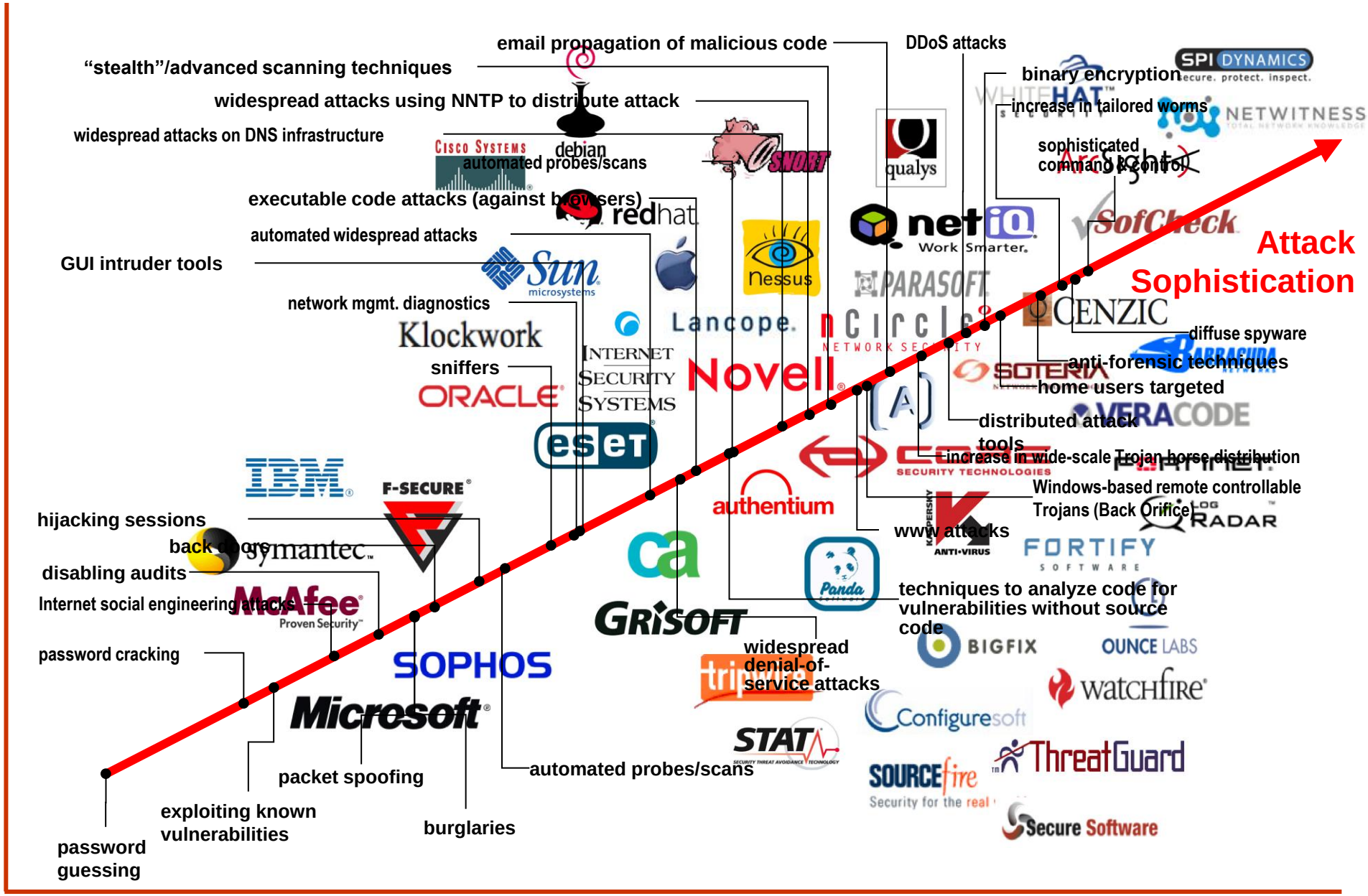
Making Security Measurable (MSM): You Are Here



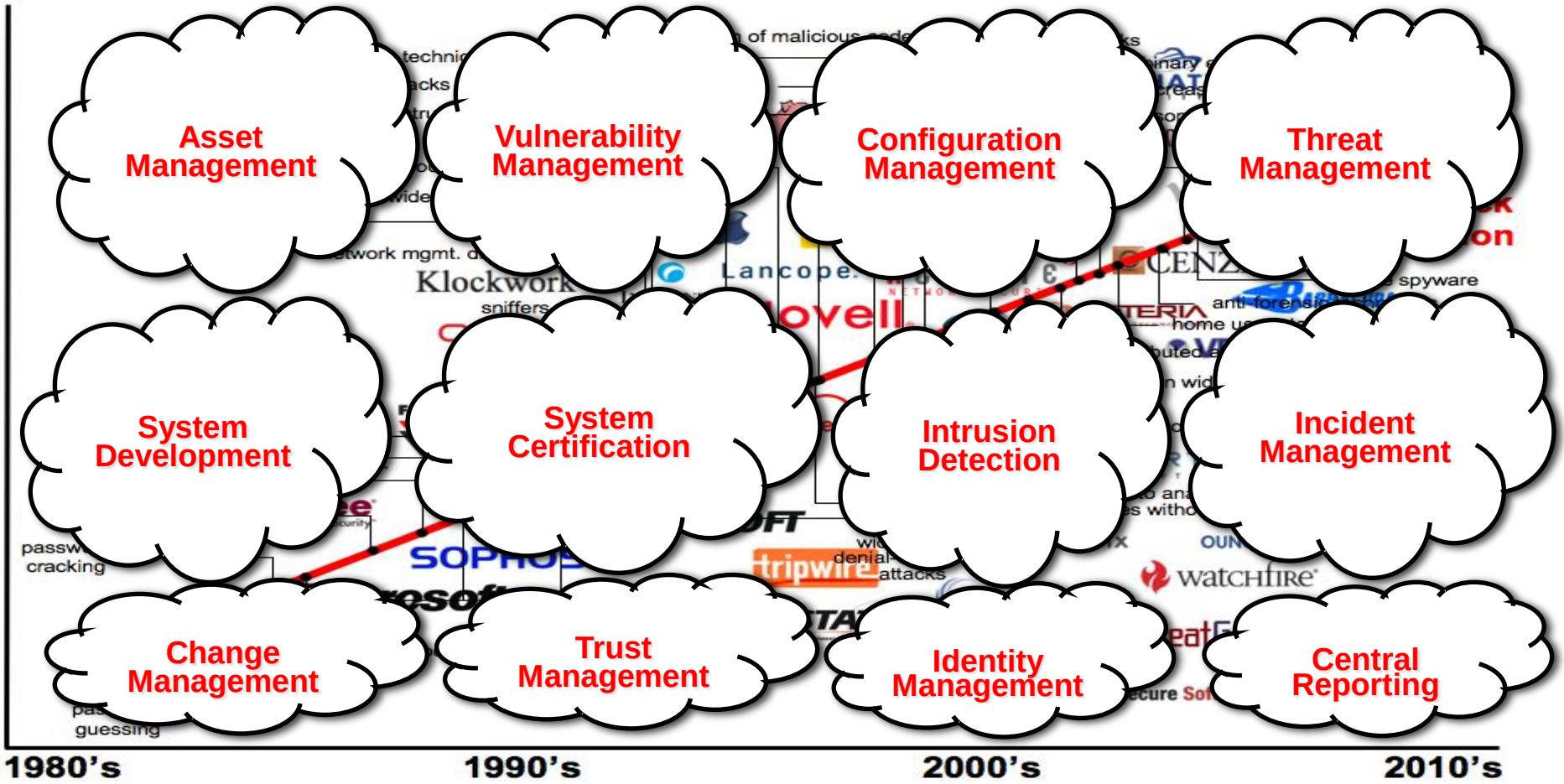
Cyber Threats Emerged Over Time



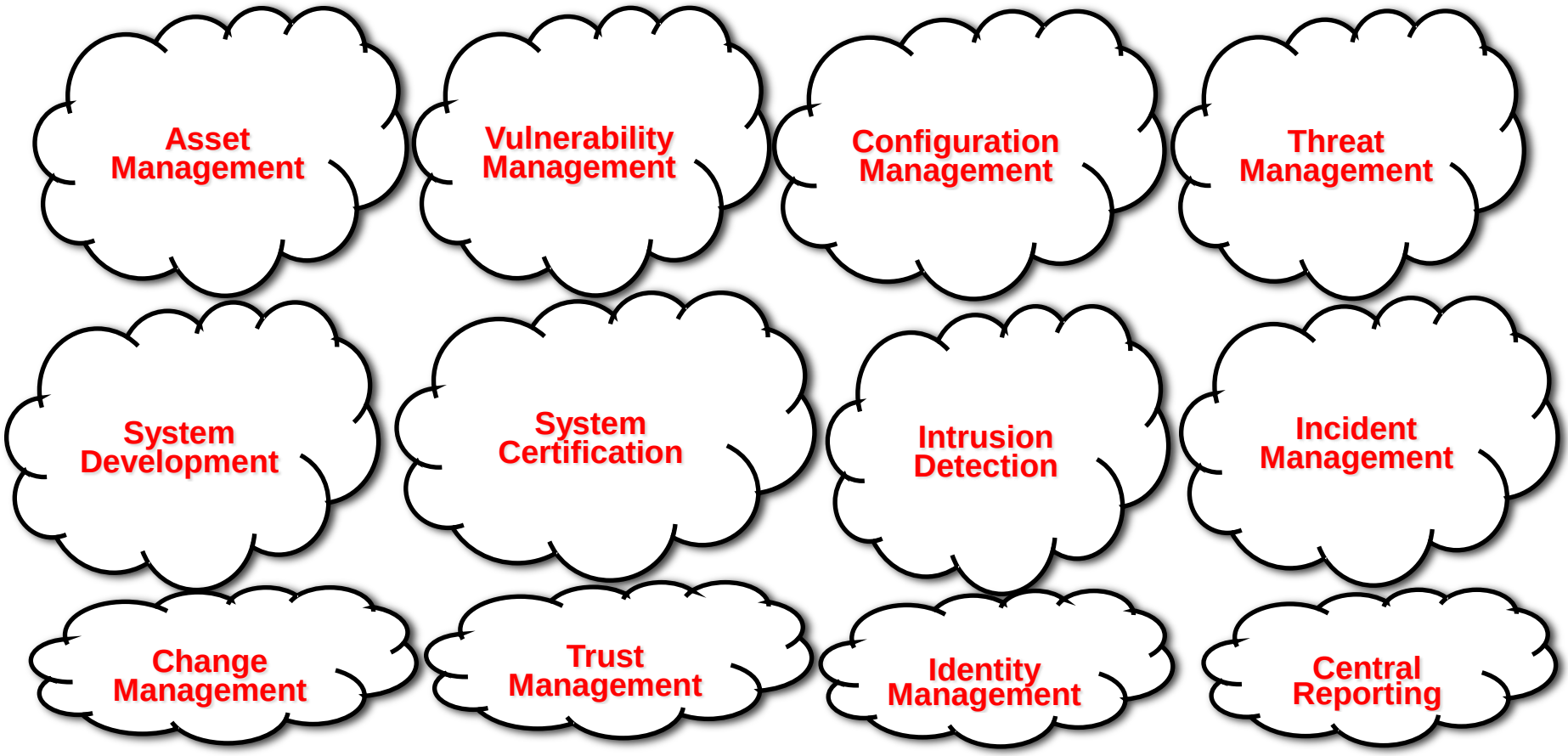
Solutions Also Emerged Over Time



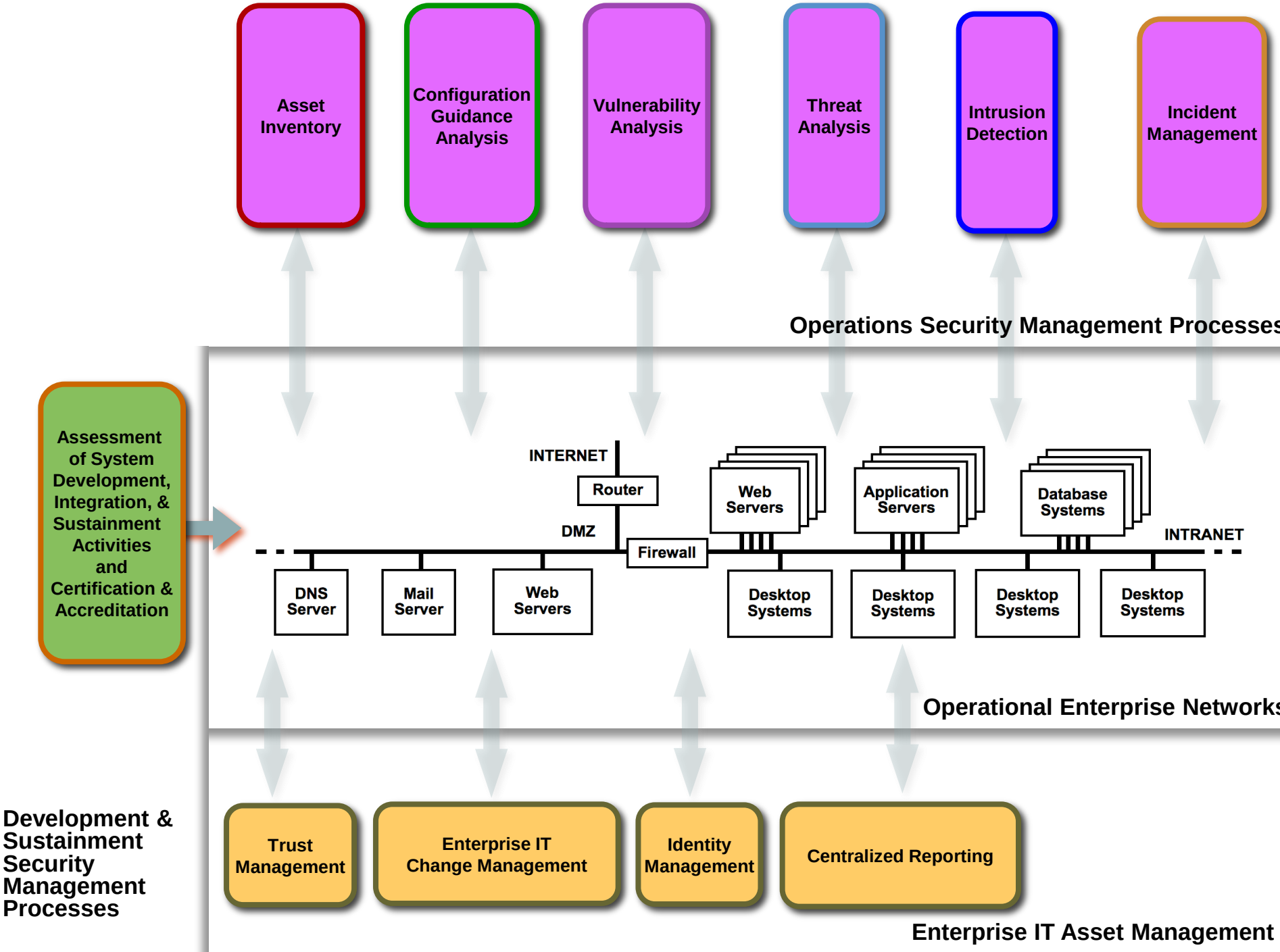
Architecting Security with Information Standards for COIs



Making Security Measurable™



Making Security Measurable™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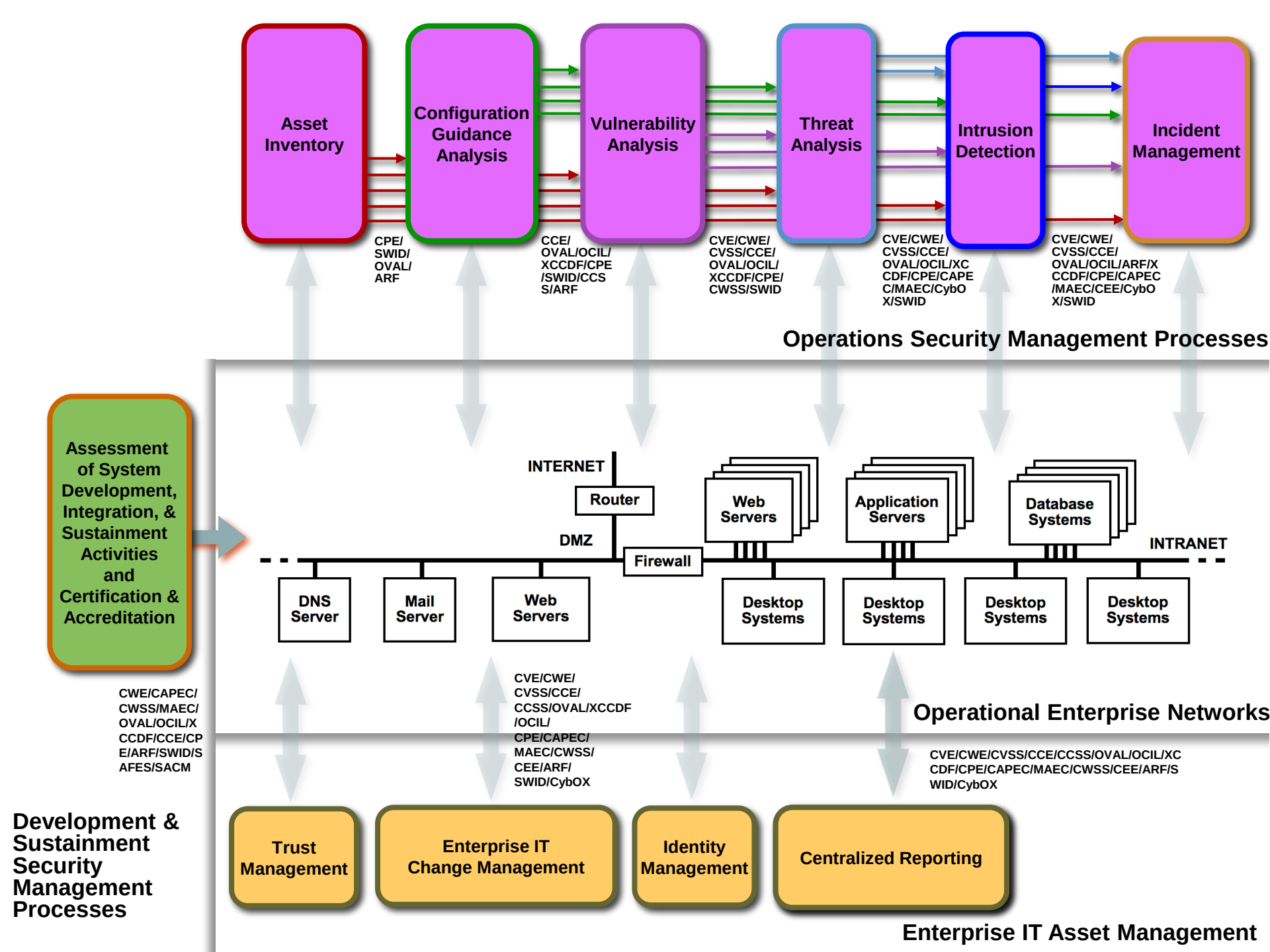
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CCE/ OVAL/OCIL/ XCCDF/CPE /SWID/CCS S/ARF
CVE/CWE/ CVSS/CCE/ OVAL/OCIL/ XCCDF/CPE/ CWSS/SWID
CVE/CWE/ CVSS/CCE/ OVAL/OCIL/XC CDF/CPE/CAPE C/MAEC/CybO X/SWID
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Identity Management
Centralized Reporting
Enterprise IT Asset Management

Cyber Ecosystem Standardization Efforts

What IT systems do I have in my enterprise?	• CPE (Platforms)
What known vulnerabilities do I need to worry about?	• CVE (Vulnerabilities)
What vulnerabilities do I need to worry about right now?	• CVSS (Scoring System)
How can I configure my systems more securely?	• CCE (Configurations)
How do I define a policy of secure configurations?	• XCCDF (Configuration Checklists)
How can I be sure my systems conform to policy?	• OVAL (Assessment Language)
How can I be sure the operation of my systems conforms to policy?	• OCIL (Interactive Language)
What weaknesses in my software could be exploited?	• CWE (Weaknesses)
What attacks can exploit which weaknesses?	• CAPEC (Attack Patterns)
How can we recognize malware & share that info?	• MAEC (Malware Attributes)
What observable behavior might put my enterprise at risk?	• CybOX (Cyber Observables)
What events should be logged, and how?	• CEE (Events)
How can I aggregate assessment results?	• ARF (Assessment Results)

Standardization Efforts leveraged by the Security Content Automation Protocol (SCAP)

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Efforts focused on mitigating risks and enabling more robust continuous monitoring and faster incident response

New FISMA reporting requirements

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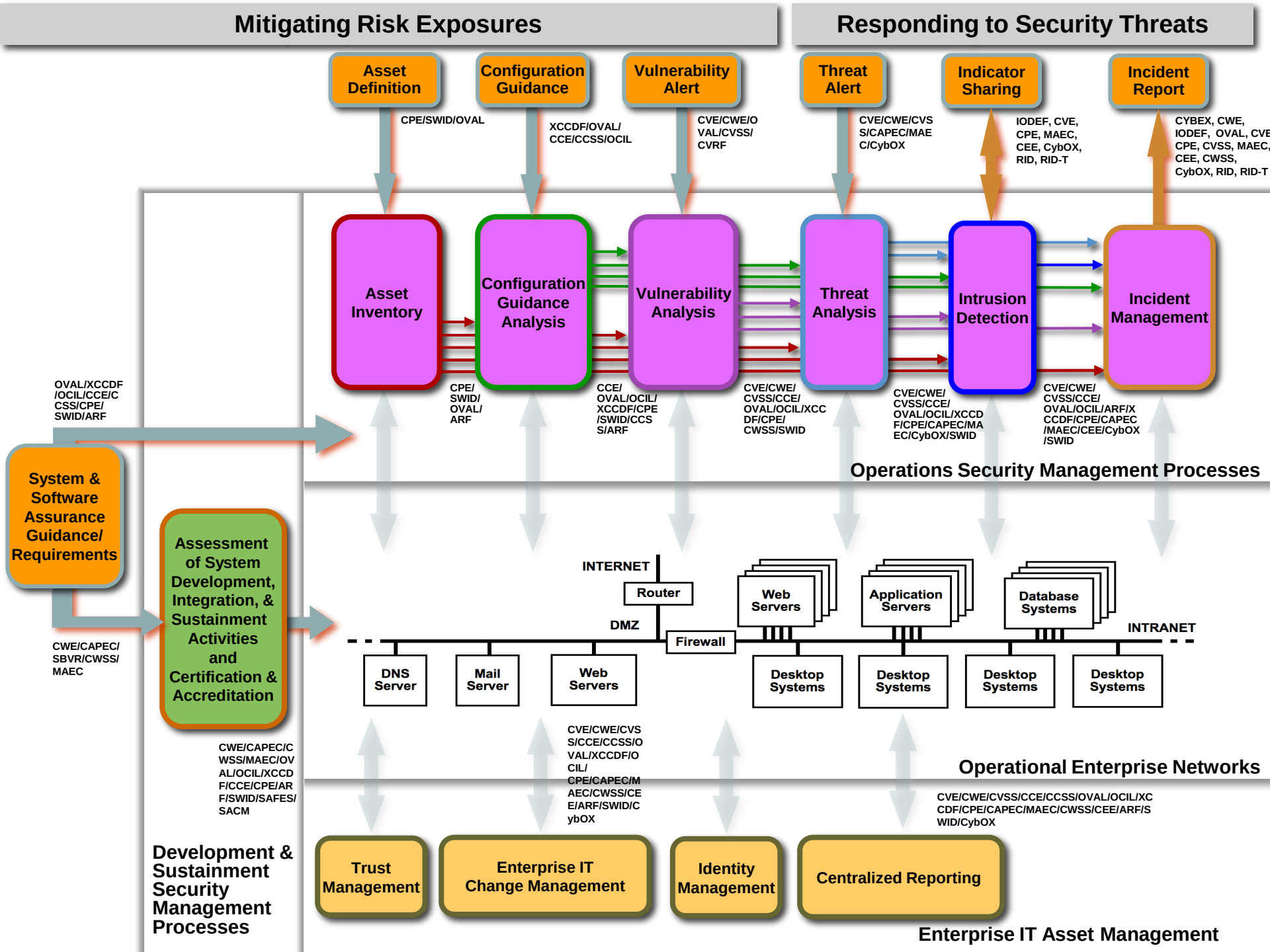
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Vulnerability Alert
Threat Alert
Indicator Sharing
Incident Report
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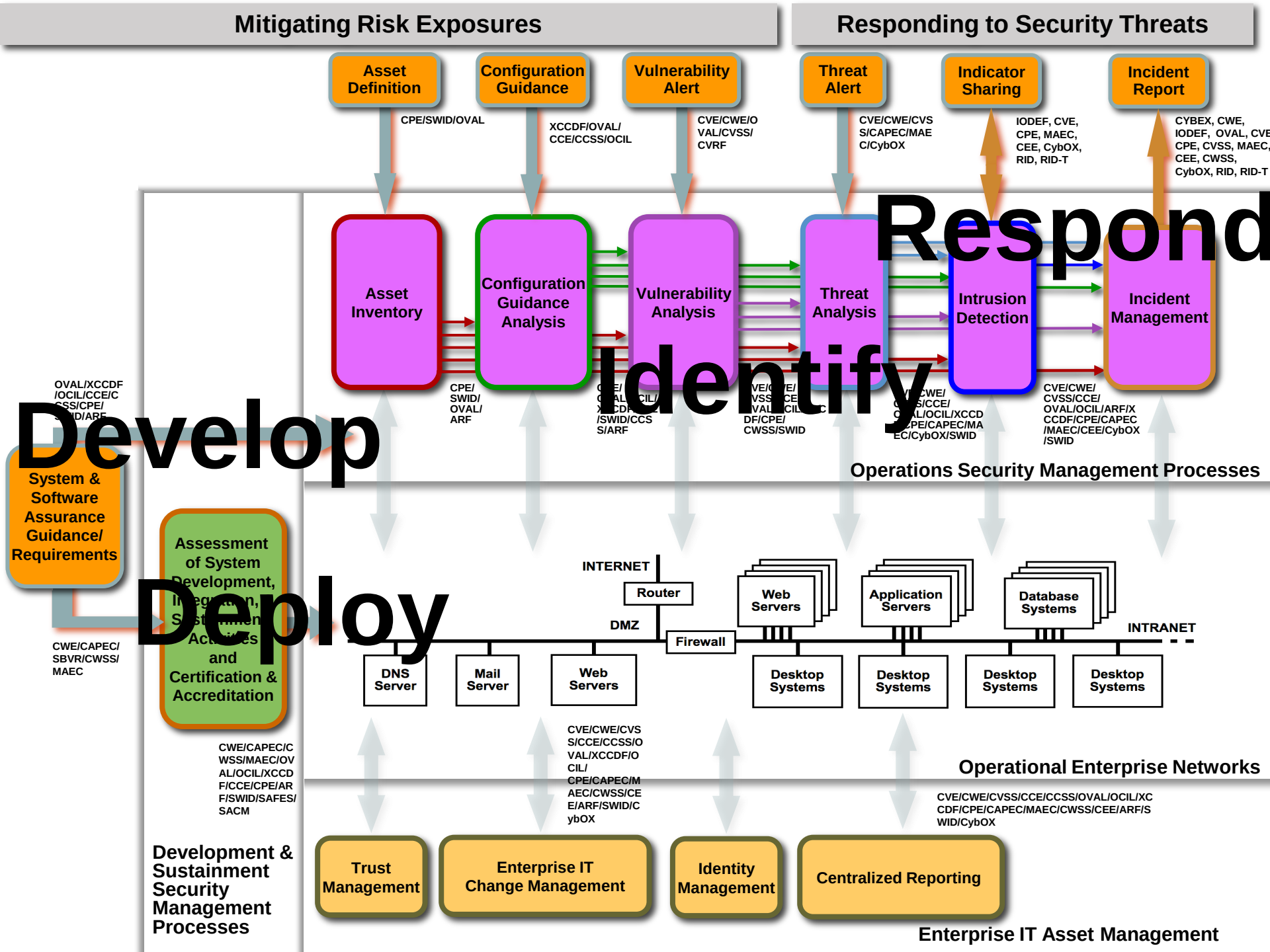
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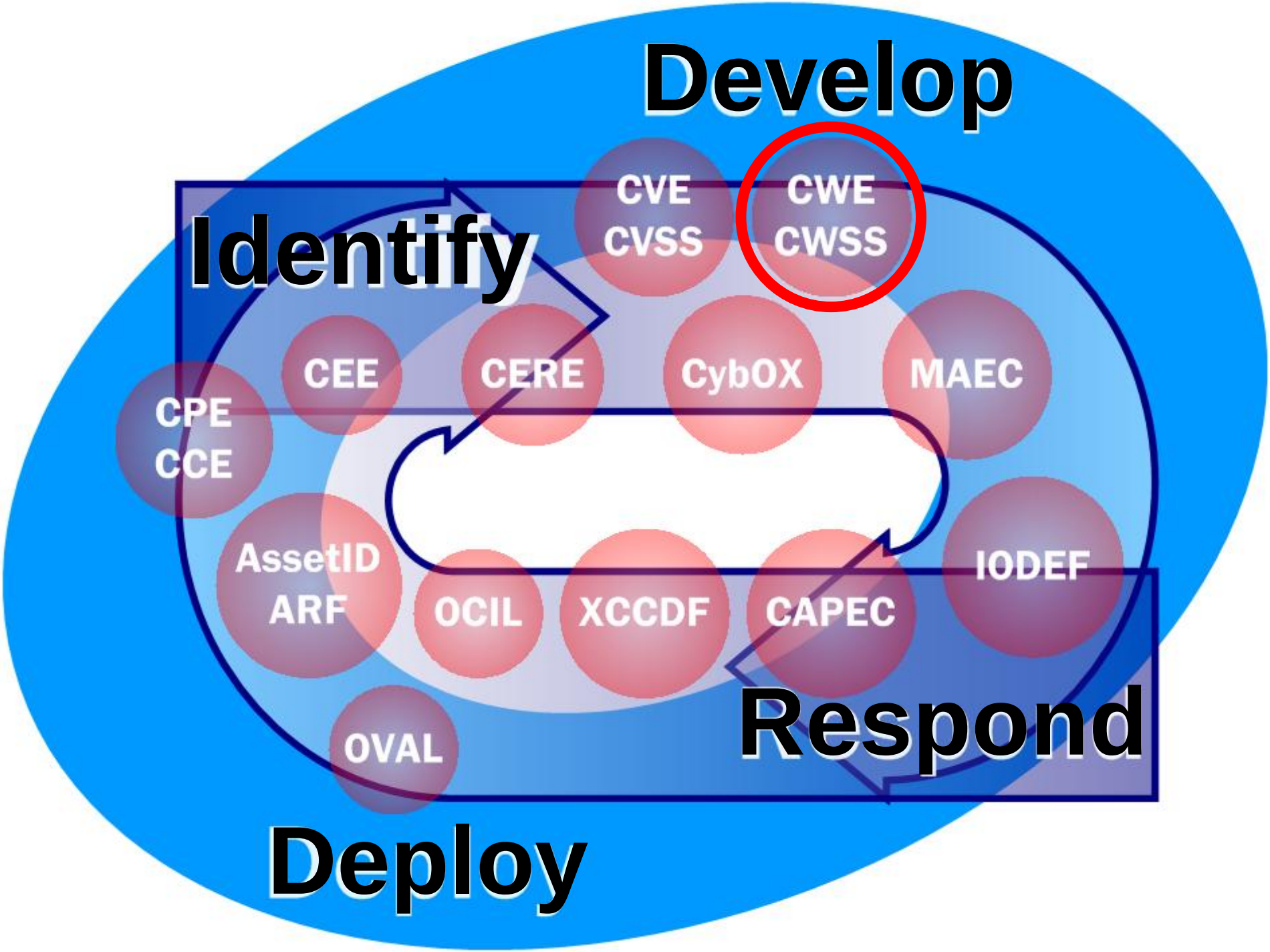
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OCIL
XCCDF
CAPEC
IODEF
OVAL

Leverage Common Weakness Enumeration (CWE) to mitigate risks to mission/business domains

CWE is a formal list of software weakness types created to:

- Serve as a common language for describing software security weaknesses in architecture, design, or code.
- Serve as a standard measuring stick for software security tools targeting these weaknesses.
- Provide a common baseline standard for weakness identification, mitigation, and prevention efforts.

Some Common Types of Software Weaknesses:

Buffer Overflows, Format Strings, Etc.
Structure and Validity Problems
Common Special Element Manipulations
Channel and Path Errors
Handler Errors
User Interface Errors
Pathname Traversal and Equivalence Errors
Authentication Errors
Resource Management Errors
Insufficient Verification of Data
Code Evaluation and Injection
Randomness and Predictability

“Making Security Measureable”:
measurablesecurity.mitre.org

Sponsored by DHS with
MITRE as technical lead

Resources provided for
voluntary adoption

Open, community efforts that
are *free* to use

XML-based

Some important things to note

What is the context?

Where can automation help - *today*?

What problems are we trying to solve?

Where do we start?

There are many definitions of “weakness” -- *in this context*

A *(software) weakness* is a property of software/ systems that, under the right conditions, may permit unintended / unauthorized behavior.

*Common Weakness Enumeration (CWE) http://cwe.mitre.org/

There are many definitions of “vulnerability” -- *in this context*:

A *(software) vulnerability* is a collection of one or more weaknesses that contain the right conditions to permit unauthorized parties to force the software to perform unintended behavior (a.k.a. “is exploitable”)

*Common Vulnerabilities and Exposures (CVE) http://cwe.mitre.org/

* Part of ITU-T Cyber Information Exchange (CYBEX) series 1500; co-sponsored by DHS NCSD

Prioritizing weaknesses to be mitigated

OWASP
The Open Web Application Security Project
http://www.owasp.org

OWASP Top 10

CWE/SANS Top 25

Lists are a good start but they are designed to be broadly applicable

We would like a way to specify priorities based on business/mission risk

Common Weakness Risk Analysis Framework (CWRAF)

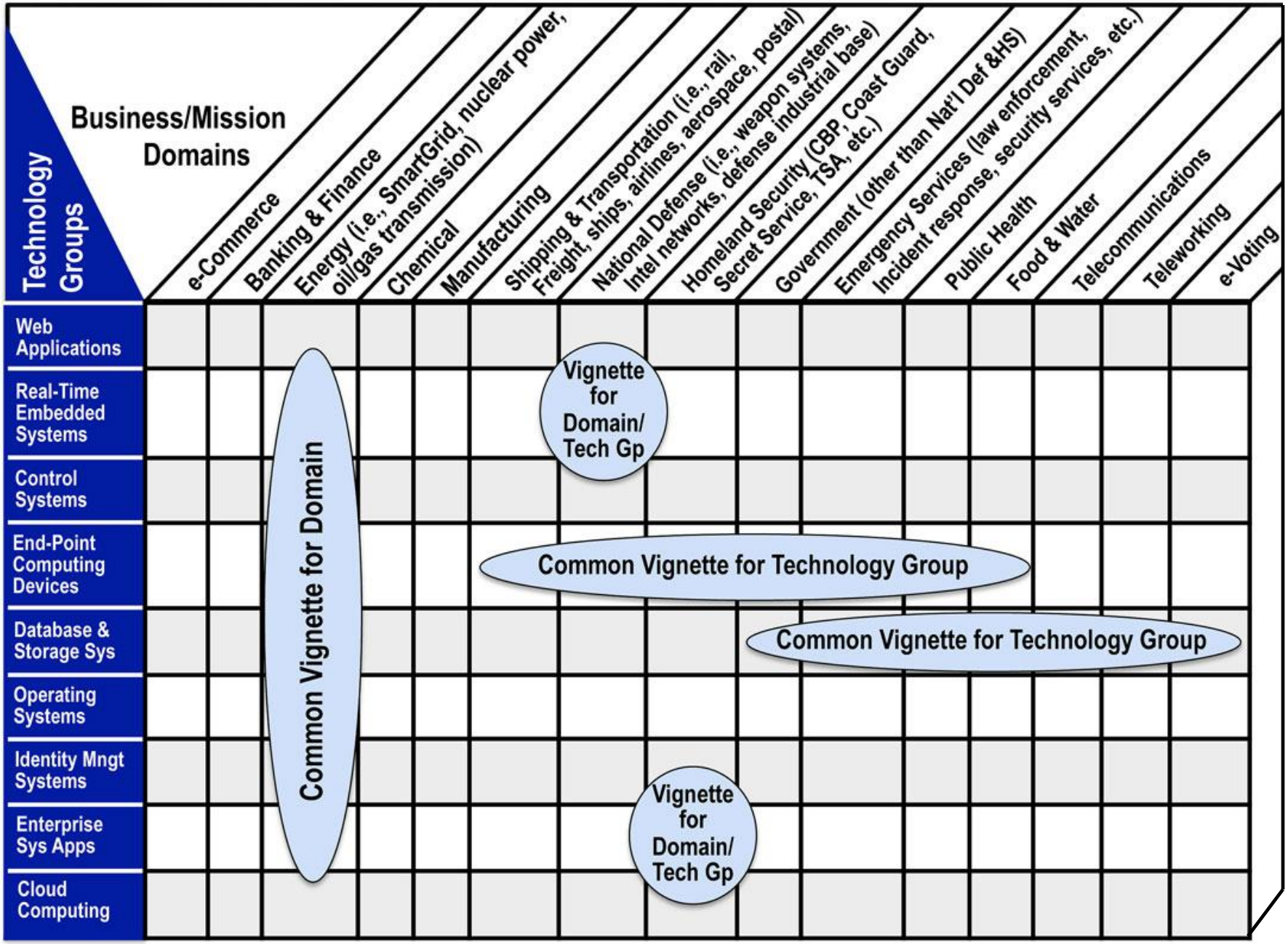
*How do I **identify** which of the 900+ CWE's are most important for my specific business domain, technologies and environment?*

Common Weakness Scoring System (CWSS)

*How do I **rank** the CWE's I care about according to my specific business domain, technologies and environment?*

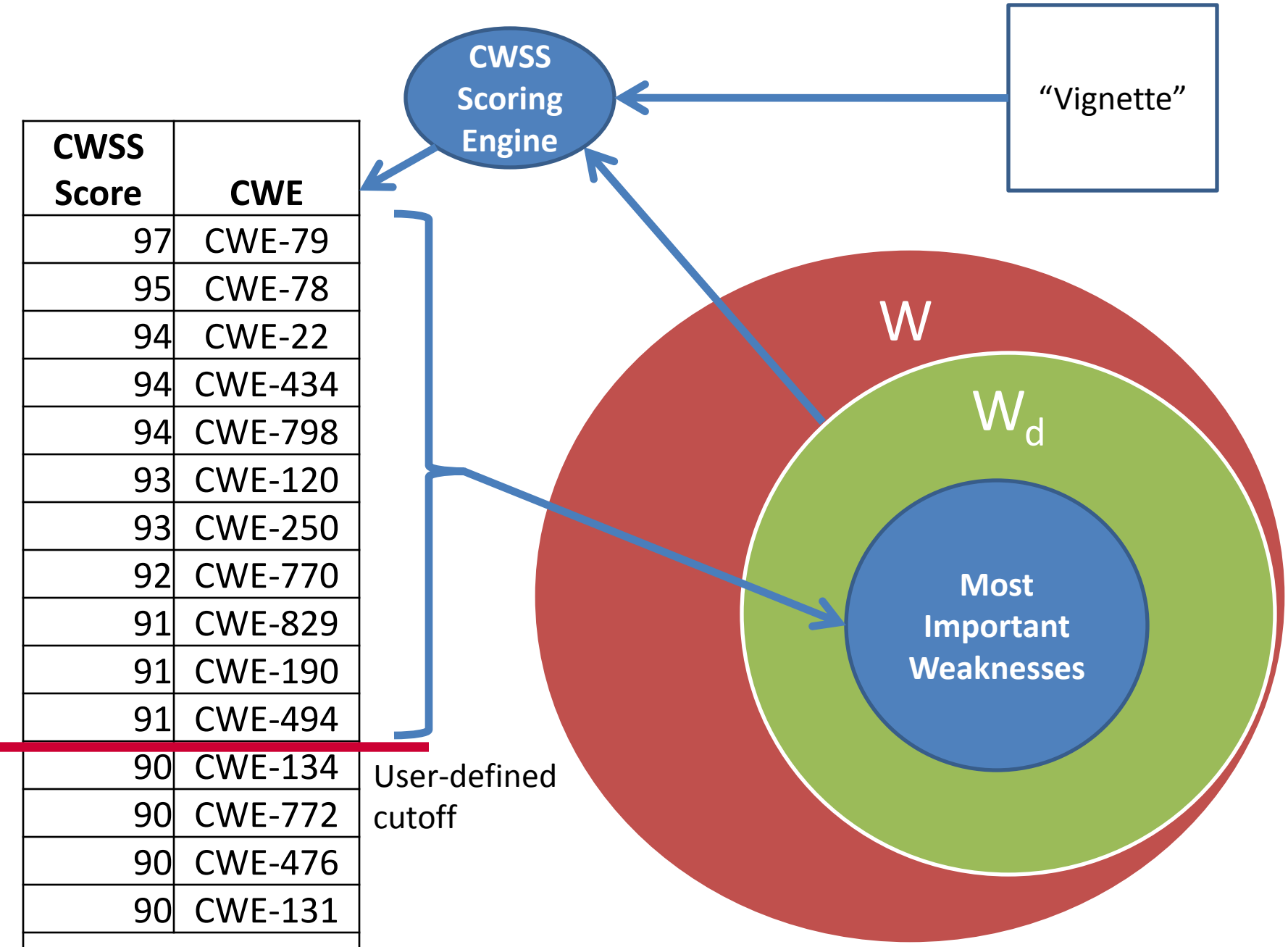
How do I identify and score weaknesses important to my organization?

Leveraging Vignettes in Cyber Security Standardization for Key ICT Applications in various Domains



Common Weakness Risk Assessment Framework uses Vignettes with Archetypes to identify top CWEs in respective Domain/Technology Groups

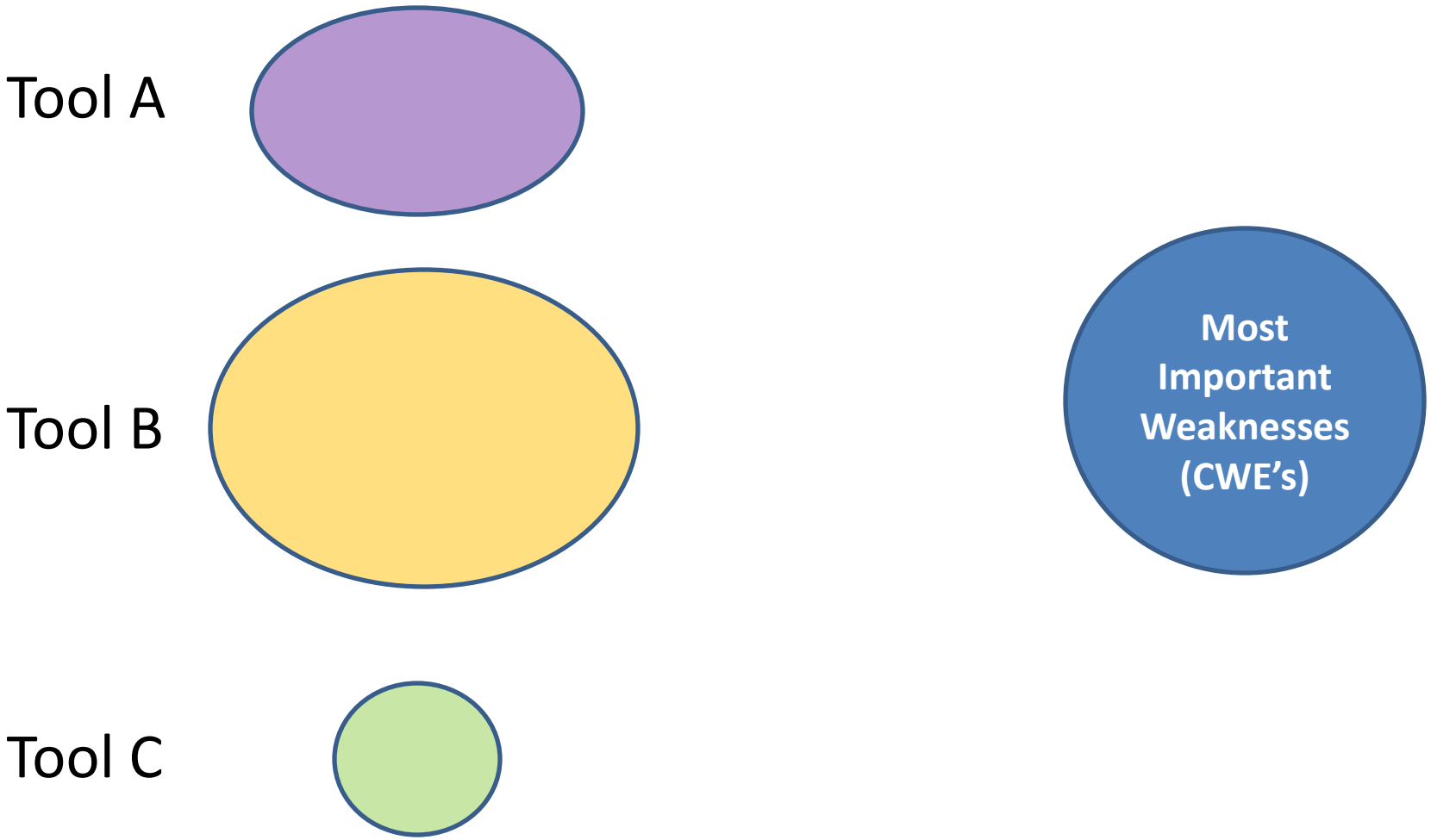
CWSS Score	CWE
97	CWE-79
95	CWE-78
94	CWE-22
94	CWE-434
94	CWE-798
93	CWE-120
93	CWE-250
92	CWE-770
91	CWE-829
91	CWE-190
91	CWE-494
90	CWE-134
90	CWE-772
90	CWE-476
90	CWE-131
…	



CWRAF/CWSS in a Nutshell

CWE Coverage Claims Representation (CCR)

Set of CWE's tool *claims* to cover

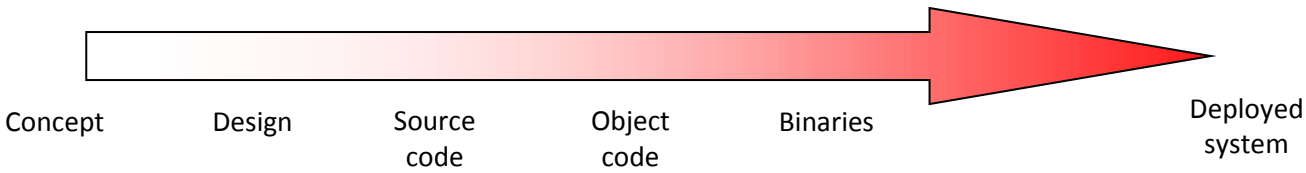


Which static analysis tools find the CWE's I care about?

CWRAF/CWSS Provides Risk Prioritization for CWE throughout Software Life Cycle

- Enables education and training to provide specific practices for eliminating software fault patterns;
- Enables developers to mitigate top risks attributable to exploitable software;
- Enables testing organizations to use suite of test tools & methods (with CWE Coverage Claims Representation) that cover applicable concerns;
- Enables users and operation organizations to deploy and use software that is more resilient and secure;
- Enables procurement organizations to specify software security expectations through acquisition of software, hosted applications and services.

When should I focus on Weaknesses and Vulnerabilities?



Focus on Weaknesses

Focus on Vulnerabilities

A type of defect that ***may be*** exploitable.

Keep Weaknesses from becoming vulnerabilities

Something in code that ***can actually*** be exploited.

Putting it all Together

What weaknesses are most important?

CWE

CWSS

Does the system contain any of those weaknesses?

What types of attacks exploit those weaknesses?

CAPEC

Does my testing cover all of those weaknesses?

Evolution of Standardized Representations - Sharing

Vulnerabilities

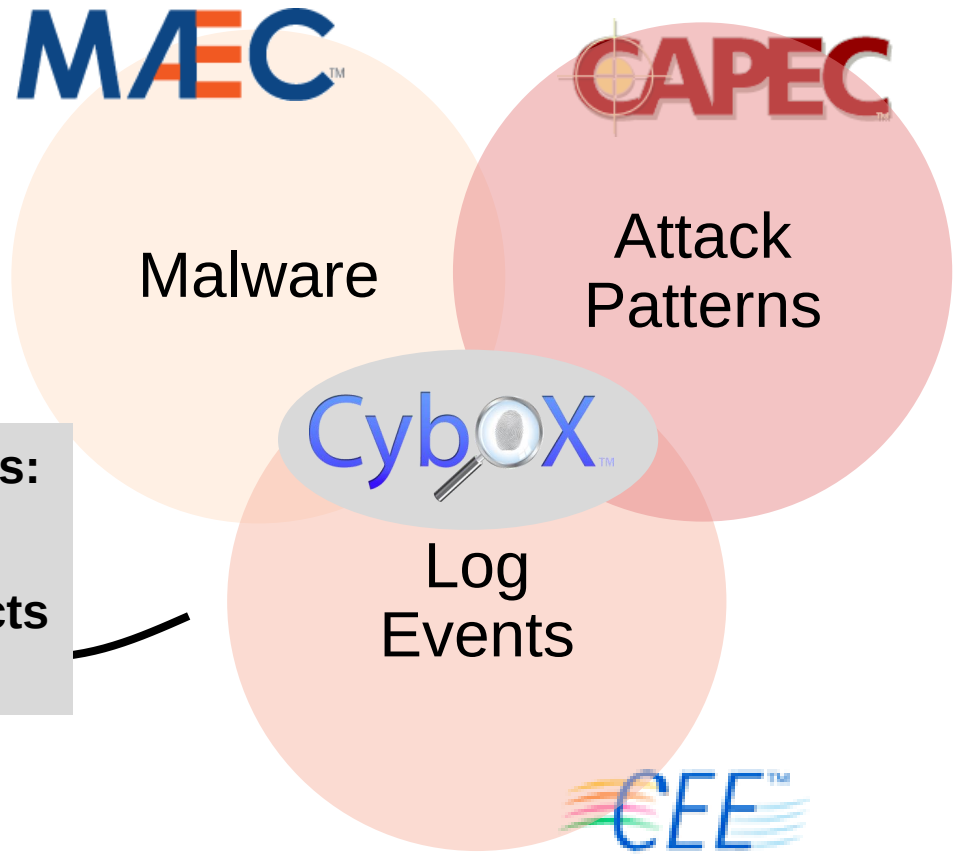
Weaknesses

Attack Patterns

Malware Behavior

Cyber Observables

? **Threat Indicators**



Imports & Extends:

- **Object**
- **Defined Objects**
- **Actions**

- **What is a cyber observable?**
  - **a *measurable event* or *stateful property* in the cyber domain**
    - **Some measurable events: a registry key is created, a file is deleted, an http GET is received, …**
    - **Some stateful properties: MD5 hash of a file, value of a registry key, existence of a mutex, …**

- **Cyber Observable eXpression (CybOX) is a standardized language for encoding and communicating information about cyber observables (http://cybox.mitre.org)**

What is STIX™

Structured Threat Information eXpression

Language

Specify **Capture** **Characterize** **Communicate**

Cyber Threat Information

Community-driven

Consistency **Clarity** **Support automation**

Structuring Threat Information for Sharing

Why were they doing it?

What you are looking for

Why should you care about it?

What exactly were they doing?

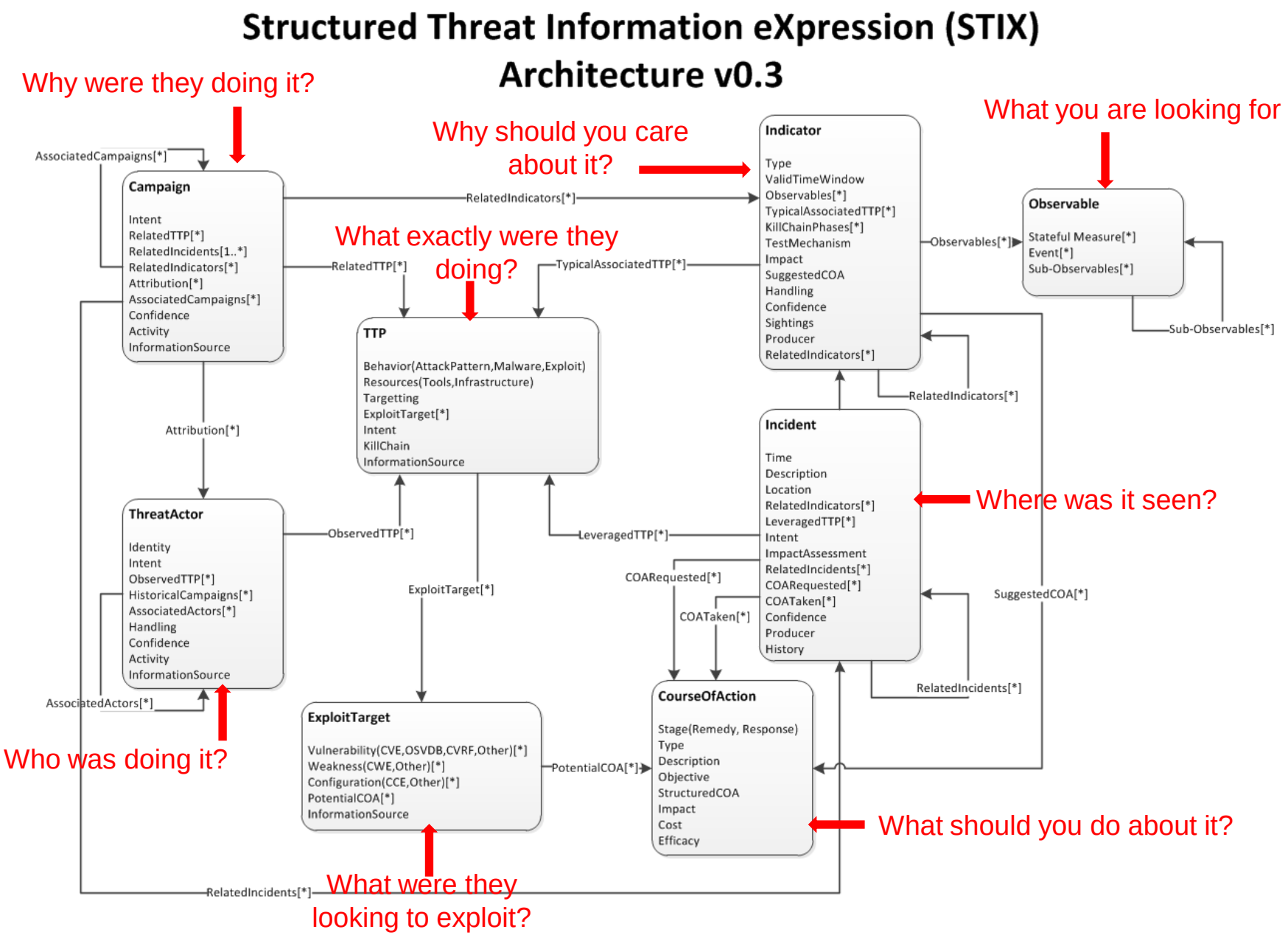
Where was it seen?

Who was doing it?

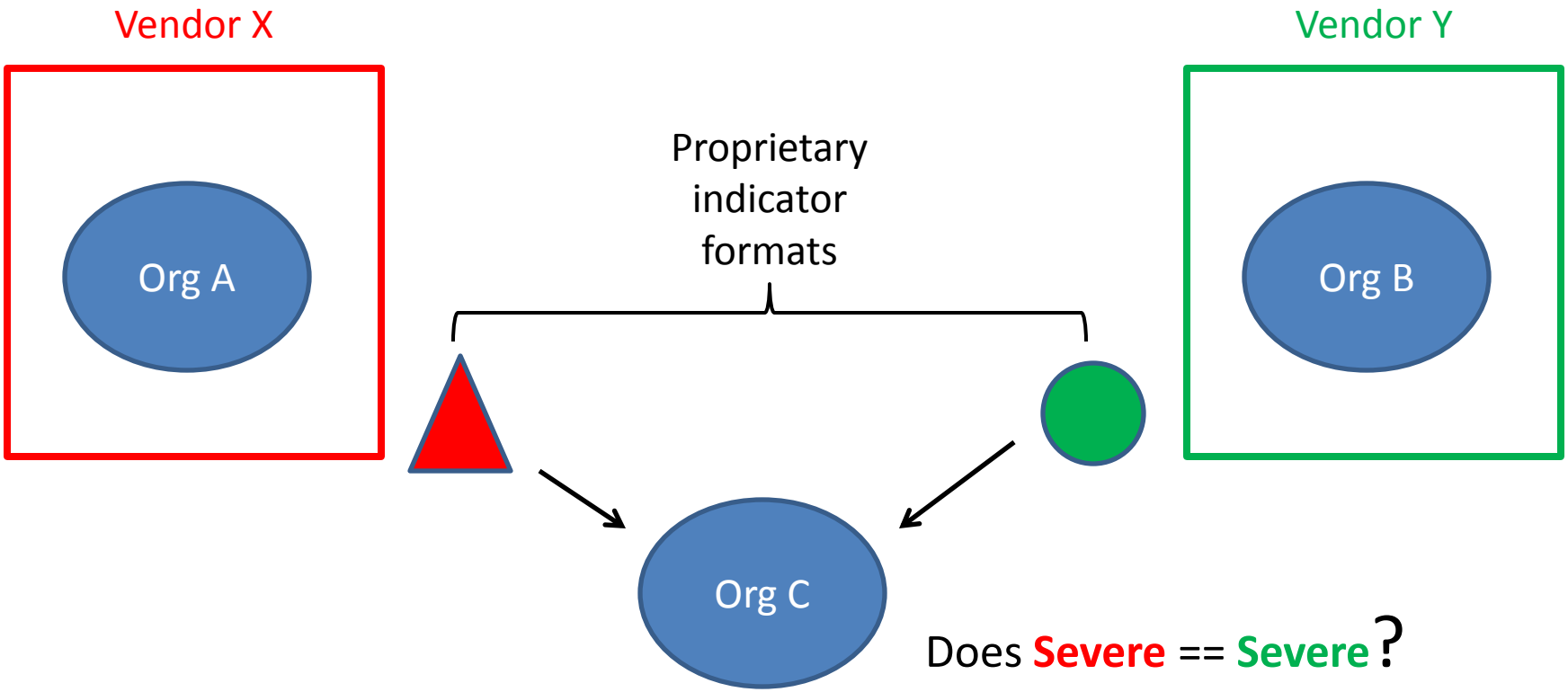
What should you do about it?

What were they looking to exploit?

STIX Architecture

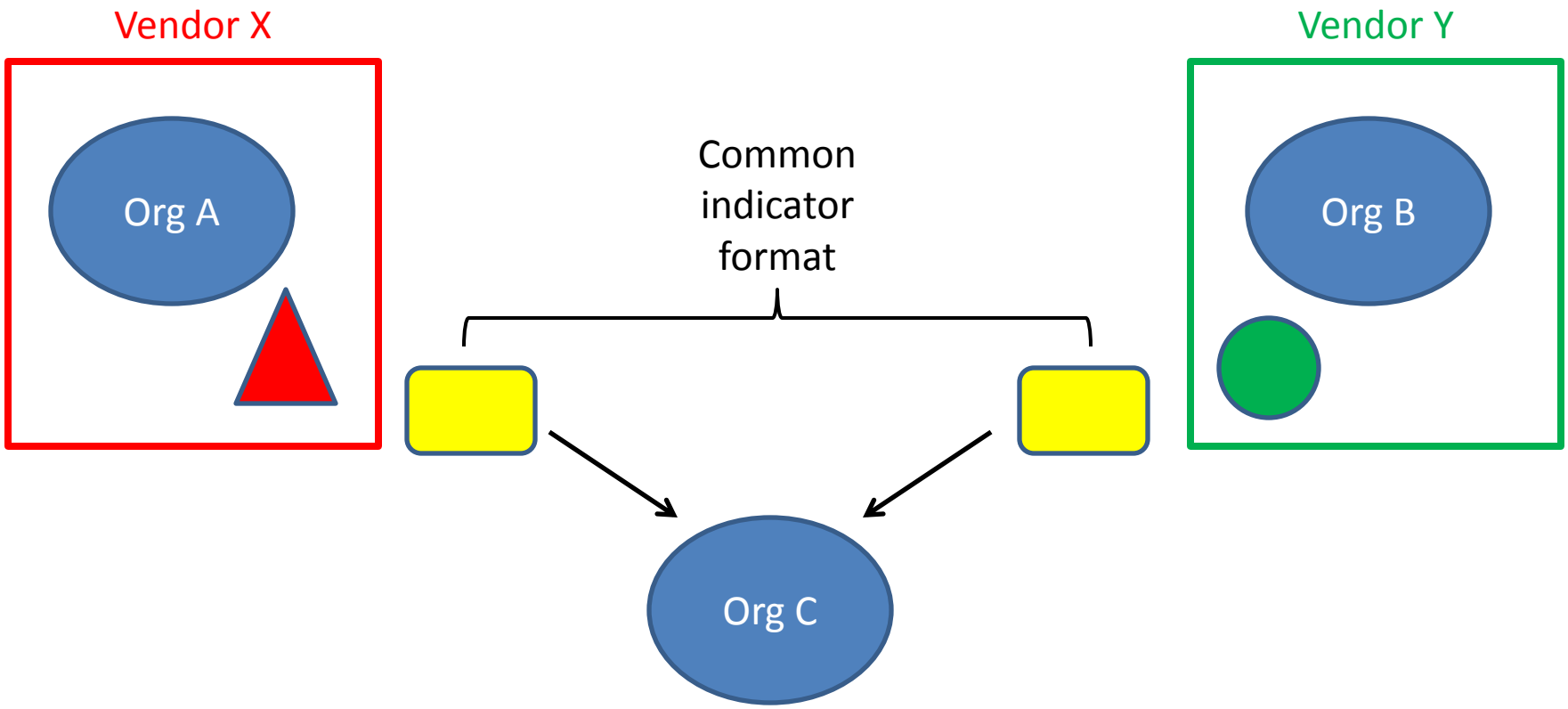


Sharing Challenges



- Org C must understand *each* format in use and try to map across formats – sacrificing time and potentially losing information
- Duplication of effort at each organization in the exchange is expensive and does not scale

Enabling Cross-Vendor Sharing



- Org C only needs to understand one format – no need to map and no information loss
- Each vendor maps their internal representations to the common format *once* – efficient and scalable

CybOX Tool Roadmap

Tool	Class	Language	Availability	License
OpenIOC -> CybOX	Translator	Python	Now	New BSD
CybOX -> OpenIOC	Translator	Python	Now	New BSD
Snort -> CybOX	Translator	Python	Now	New BSD
Email -> CybOX	Transform	Python	Now	New BSD
CybOX -> Snort	Translator	Python	Now	New BSD
IODEF -> CybOX	Translator	Python	Now	New BSD
CybOX -> Suricata	Translator	Python	12/12	New BSD
Suricata -> CybOX	Translator	Python	12/12	New BSD
CybOX Python Bindings	Bindings	Python	Now	New BSD

BSD license is a very open license, allowing you to do practically anything with the software. It's less restrictive than the GPL, but more restrictive than the Public Domain. There are only a couple precepts that must be adhered to, when using this license:
•You are free to redistribute the software, in binary or source form, as long as the copyright, conditions and disclaimer are present.
•You cannot use the name of originating organization or contributors to promote derivatives of the software, without written consent.

If adhered to, you are free to modify, copy and redistribute BSD-licensed software in either source or binary form as you see fit. You are not required to return code or patches to the upstream BSD-licensed software. You are free to change the license, or charge for derivatives, of the software, be it commercial or proprietary.

MAEC Tool Roadmap

Tool	Class	Language	Current Support	Avail.	License
MAEC/CybOX Python Bindings	Bindings	Python	MAEC v2.1/CybOX 1.0	Now	New BSD
MAEC -> OVAL	Translator	Python	MAEC v2.1	Now	New BSD
Anubis -> MAEC	Translator	Python	MAEC v2.1/CybOX 1.0	Now	New BSD
ThreatExpert -> MAEC	Translator	Python	MAEC v1.1	Now	New BSD
GFI Sandbox -> MAEC	Translator	Python	MAEC v2.1	Now	New BSD
FireEye -> MAEC	Translator	Python	n/a -- in develop.	TBD	New BSD
Norman Sandbox -> MAEC	Translator	Python	n/a -- in develop.	TBD	New BSD
PEFile -> MAEC	Translator	Python	n/a -- in develop.	Now	New BSD
MAEC -> Suricata	Translator	Python	n/a – in develop.	12/12	New BSD
MAEC -> HTML	Translator	XSLT	MAEC v2.1	Now	New BSD
MAEC Comparator	Analysis	Python	MAEC v2.1	Now	New BSD

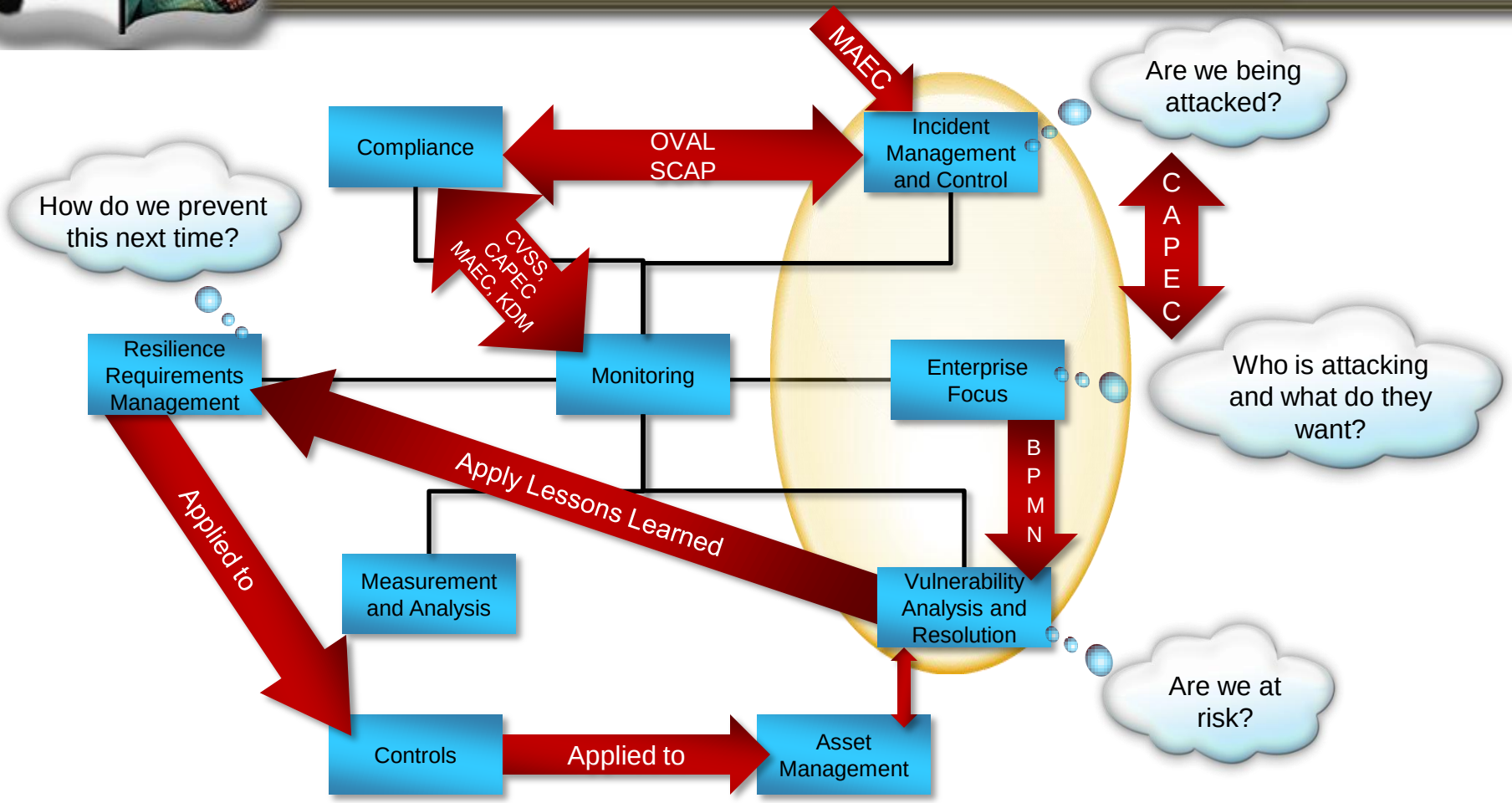
automation can help…

- Common Weakness Enumeration (**CWE**)
- Common Attack Pattern Enumeration and Classification (**CAPEC**)
- CWE Coverage Claims Representation (**CCR**)

- Common Weakness Enumeration (**CWE**)
- Common Weakness Risk Analysis Framework (**CWRAF**)
- Common Weakness Scoring System (**CWSS**)
- Common Attack Pattern Enumeration and Classification (**CAPEC**)
- CWE Coverage Claims Representation (**CCR**)

- Common Vulnerabilities and Exposures (**CVE**)
- Open Vulnerability Assessment Language (**OVAL**)
- Malware Attribute Enumeration and Characterization **(MAEC)**
- Cyber Obersvables eXpression **(CybOX)**

SwA and Operational Resilience



Adapted from September 2010 SwA Forum, CERT RMM for Assurance , Lisa Young, SEI

Courtesy of Michele Moss

SOFTWARE ASSURANCE FORUM

BUILDING SECURITY IN

Free Resources and Events

SwA Forum – Next session: 5-7 Mar 2013 @ NIST in Gaithersburg, MD

SwA Working Group Sessions: June 2013 @ MITRE in McLean, VA

SwA Websites: www.us-cert.gov/swa

Email: software.assurance@dhs.gov

Making Security Measureable: measurablesecurity.mitre.org

See Language for sharing exchange of indicators and correlation of incident information -- Cyber Observables eXpression (CybOX) at http://cybox.mitre.org

IT/Software Supply Chain Management is a National Security & Economic Issue

- Adversaries can gain “intimate access” to target systems, especially in a global supply chain that offers limited transparency
- Advances in science and technology will always outpace the ability of government and industry to react with new policies and standards
  - National security policies must conform with international laws and agreements while preserving a nation’s rights and freedoms, and protecting a nation’s self interests and economic goals;
  - Forward-looking policies can adapt to the new world of global supply chains;
  - Standards for automation, processes, and products must mature to better address supply chain risk management, systems/software assurance, and the exchange of information and indicators for cyber security;
  - Assurance Rating Schemes for software products and organizations are needed.
- IT/software suppliers and buyers can take more deliberate actions to security-enhance their processes, practices and products to mitigate risks
  - Government & Industry have significant leadership roles in solving this
  - Individuals can influence the way their organizations adopt security practices

Homeland Security

Globalization will not be reversed; this is how we conduct business – To remain relevant, standards and capability benchmarking measures must address “assurance” mechanisms needed to manage IT/Software Supply Chain risks.

Next SwA Forum at 5-7 March 2013 at NIST in Gaithersburg MD

SOFTWARE ASSURANCE FORUM

"Building Security In"

https://buildsecurityin.us-cert.gov/swa

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Homeland Security