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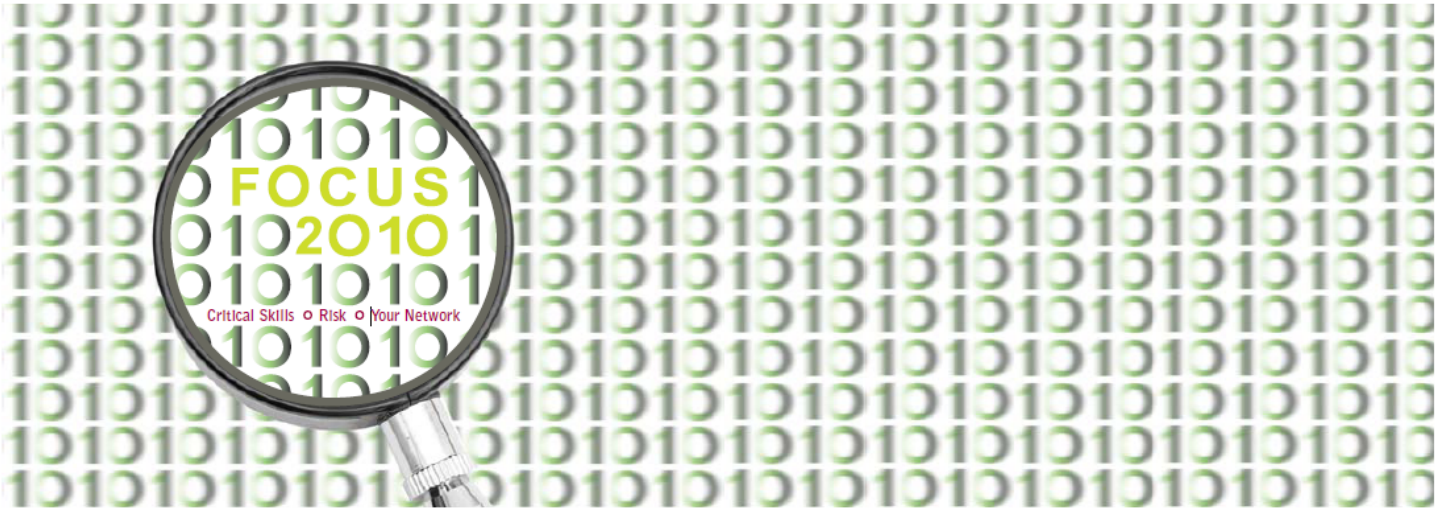

T33: Application Threat Modeling: Evolving Risk Management of Business Applications

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ISACA®

Trust in, and value from, information systems

San Francisco Chapter

Threat Modeling Application Environments for Improved Risk Management

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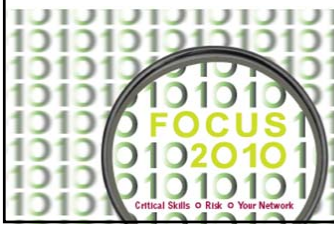


THE PROBLEM

Risk Assessments Losing Credibility

- A lot of theoretical scenarios
  - "If A & B takes place, C could happen"
  - Difficult to provide for accurate quantitative values
  - Control frameworks can't predict the future

Lacks a Hybrid Approach

- Too high level business (pure risk assessment)
- Too techno focused detail (technical risk assessments – vuln scans, static analysis)
- Doesn't integrate to many sources of risk information

Adversarial Approach

- "Us vs. Them" Mentality
- Reduces Criticality of Security Message
- Does not invite collaborative unity toward a single security goal

STATUS QUO FEEDBACK

ASIS/ SIA Risk Assessment Survey (2007)

Question: "Clearly, risk assessment is important, but the real question is this: Are U.S. security practitioners actually conducting risk assessments, and, if so, how are those risk assessments being used? "

ASIS/ SIA Risk Assessment Survey Scope

- Respondents and their organizations represented a broad cross-section of the following industries:
  - agriculture, education, entertainment venues, financial/legal/business professional services, government, health care, hospitality, industrial/manufacturing, information technology/telecommunications/high tech, retail outlets, senior facilities/assisted living, theme parks, warehousing, and many others

ASIS/ SIA Risk Assessment Survey Results

- About one-third of respondents fail to conduct cost-benefit analyses when evaluating options to mitigate risk.
- One-third of security practitioners who perform risk assessments believe their assessments are futile and could not be the basis of a security upgrade.
- Less than half of respondents measure the effectiveness of security systems after installation.
- Between one-third and one-half of respondents do not install security equipment or make other security upgrades in response to a risk assessment.
- About one-third of respondents fail to conduct cost-benefit analyses when evaluating options to mitigate risk.

Bad Press for Security Risk

A SOLUTION

Application Threat Modeling for the Masses

- Builds an attack plan
  - Think like an attacker
  - Conceptualize likely attacks
  - Software Development Life Cycles (SDLC) Integration
  - Migrating from speculative risk scenarios to likely attack vectors

Integrating the What Could Happen ?

- Vulnerability Assessment results reveal areas of weakness
- Pen Testing results provide probabilistic values for exploiting identified vulns
- Static Analysis results for vulnerable code and program objects
- Social Engineering exercises reveals secure unawareness

Integrating the What Does/ Did Happen ?

- Security Incident Data Feeds
- Intrusion Prevention/ Detection Systems
- Firewalls
- Host Based Agents
- Web Application Firewalls (WAFs)

Integrating the What We Got ?

- Security Governance in Action – Finally!
- Policies & Procedures as administrative controls for process related threats
- Standards as countermeasures for application / platform/ network related threats
- Exceptions reveal slightly open 'windows'

Mapping Threat Model Results to Risk Values

- Elevates (legitimizes) probability values
- Incorporate Business Impact Analysis (BIAs) into threat model for quantifying impact
- Provides a tactical scope for application assessments

Threat Modeling Drivers for Building Security In

- Reducing the cost of remediation $$$
- Reducing Knee-Jerk Exception Handling $$
- Introduce Security Awareness as part of OJT $
- Security = > Efficiency $$$

SecuriLocks & the 3 Bears

Taxonomy of Terms

Actors/ Assets (Targets)

- End users that use thick, thin client applications (userID: bsmith, sue.taylor, etc)
- System administrators who regularly interact/ support any part of the application ecosystem
- Achieved via Data Flow Diagramming
- Application accounts used for automated or batched APIs or data interfaces
- Threat modeling terminology lends from Risk Management, Software Development, and IT Architecture

Roles & Privileges

- Rights awarded to pre-defined groups or users for application
- Addresses issues related to impersonation, federated identities in applications
- C.R.U.D analysis (rights to Create, Read, Update, and Delete) across use cases
- Under what security context do you handle report creation, authentication, sensitive transactions, delete account, etc?

Countermeasures

- Equate to controls in risk
- Aimed at mitigating threats and attacks
- Clear injection points for use revealed by threat modeling
- Protection against real risk

Use/ Misuse Cases

- Allows for use cases to be built from functional & security requirements – fat apps are vulnerable!
- Defines branches in attack tree to which attacks, vulns, exploits are correlated
- Defines how the apps can be used & misused
- Business logic flaws finally addressed

Data Flow Diagramming (DFD)

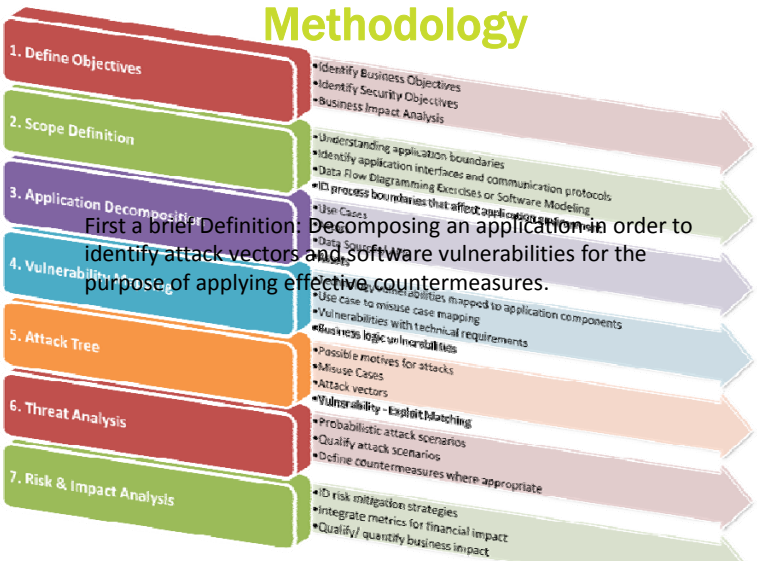
- Steps through the lifecycle of data through an application; application walk through
- Maps out data interfaces across application layers (presentation, app, data, etc)
- Allows for countermeasures to be identified as part of data in transit, while processing, and in storage
- Incorporates actors and assets as data flow start & end points

Trust Boundaries

- Boundaries that define where trust should be granted and to what degree
- Allows for the consideration of new threats (privilege escalation, etc) and countermeasures (authentication controls) that relate to trust amongst application calls

Methodology

Methodology



First a brief Definition: Decomposing an application in order to identify attack vectors and software vulnerabilities for the purpose of applying effective countermeasures.

Thank You!

Threat Modeling Methodology Myths

- No widely accepted methodology exists today.
- By widely, we simply mean no organization has defined and patented a threat modeling
- STRIDE & DREAD are not methodologies, threat and risk classifications respectively

Key Components to Threat Modeling

- Steps 3,4,5,6 equate to 'secret sauce'
- Step 3: App Decomposition allows for greater understanding of app to all involved parties (threat modeler, developers, architects, sys admins)
- Step 4: Vuln Mapping integrates unmanaged vulnerabilities in order to ID a window for an exploit. Something to worry about.
- Step 5: Attack Tree evolves beyond the theoretical to lets let our guys try to exploit this
- Step 6: Threat Analysis shows the net effect of vulns * attacks - countermeasures

What Threat Modeling is NOT

Beyond The Hype

- As with any new buzz in security, its not long before a good thing mutates in meaning and application
- Not a replacement for risk assessments
  - Risk assessments have their place for ongoing risk analysis of deployed application environment
  - Still the preferred choice for vendor applications (tough to build a detailed threat model on vendor application environments)
  - Risk assessments benefit from threat modeling deliverables for an improved and targeted risk analysis

Threat Modeling Distortion

- Not a loosely defined exercise to complete a check box
- An attack tree does is not a threat model
- A data flow diagram (DFD) is not a threat model
- Breaking up bits and pieces of the threat modeling methodology is just that – a broken or incomplete threat model

Not Another Silver Bullet

- Aimed at elevating the predictive nature of risk analysis by understanding viable threats and attack patterns for apps
- Still warrants and depends on auxiliary processes and disciplines across security, compliance, and IT
  - Vuln mgt,
  - Business impact analysis,
  - Security governance (policy/ standard mgt),
  - Incident analysis & response,
  - DLP solutions,
  - Network Operations
- Requires a collaborative work environment
  - Barriers to information gathering poses a problem

Facets of Threat Modeling

Threat Modeling ACME Company

- SDLC Efforts – Define & Design Time
  - PMs, business analysts, business owners devise functional requirements (Definition Phase)
  - Architects and IT Leaders speak to architectural design and platform solutions (Design Phase)
  - Governance leaders inject compliance & standards requirements for during he design phase; BIA
  - Threat Model* (SOC/ NOC fed), DFDs Introduced, Trust Boundaries defined, Countermeasures proposed

ACME Example – Dev Time

- Time to Write the Code - Development
  - Incorporates both functional & security reqs.
  - Developers now more aware of potential threats
- Countermeasures developed within applications
  - Validation Checks
  - Reduced Privs
  - Proper encoding techniques

Be the BlackHat

- Discovering Vulns & Applying Attacks
- QA tests functional features; scope creep in use cases
- Threat modeler tests for vulns, exploit opportunities, config flaws, logic flaws, bad design
- QA can serve as security testing group
  - Rising trend to leverage QA
- Sanely be Dr. Jekyl/ Mr. Hyde

Threat Identification & Impact

- Enumerate the threats to the application elements
  - PII theft
  - IP theft
  - Sabotage driven threats
  - Malware upload
- Identify the impact for the most likely attack vectors
  - Social engineered emails
  - Web Forms/ Fields
  - Email related auxiliaries uses to web apps
  - Other data interfaces supporting web application environment

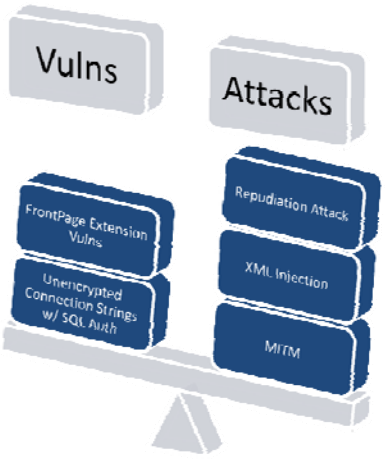
Use cases/ vulns beget misuse cases

- Every function has a potential dysfunction; need to enumerate and test application functions
- Listing of vulns for mapping can originate from subscribed vulnerability feeds/ vulnerability signatures from vendors
- Some Sources: SecurityFocus, US-CERT, Symantec, Microsoft
- Map vulns to employed platforms and software technologies
- Attack tree begins to take shape

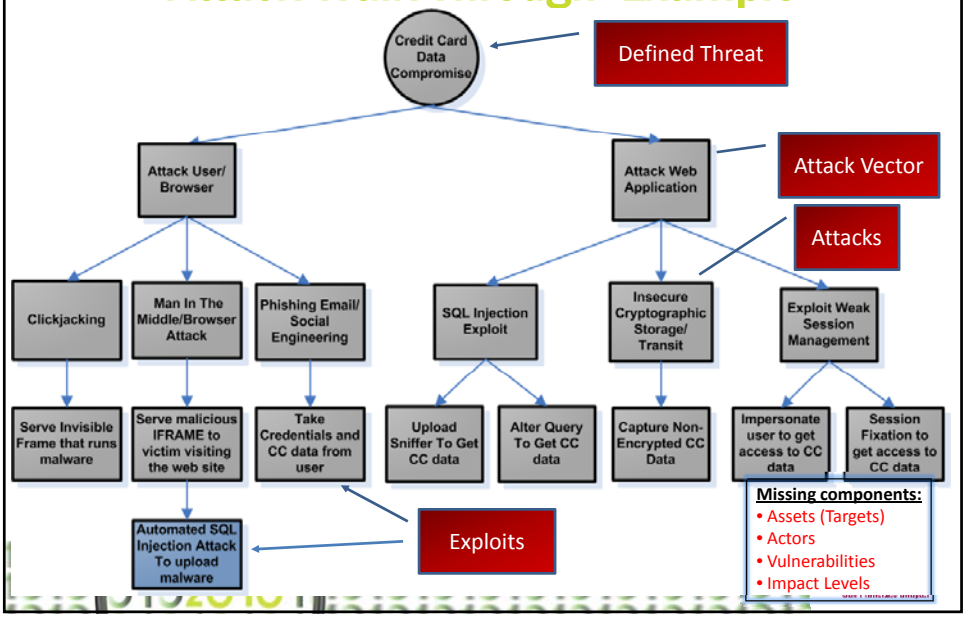
Mapping Use Cases to Misuse Cases

Misuse cases/ vulns beget exploits

- Exploitation is the proof. We all need proof.
- Given time constraints, partial exploits may be acceptable; educating that attacks are layered.
- Exploitation may address identified vulns, business logic flaws, and/ or non-published vulnerabilities



Attack Walk Through Example



Data Flow Diagramming Exercises

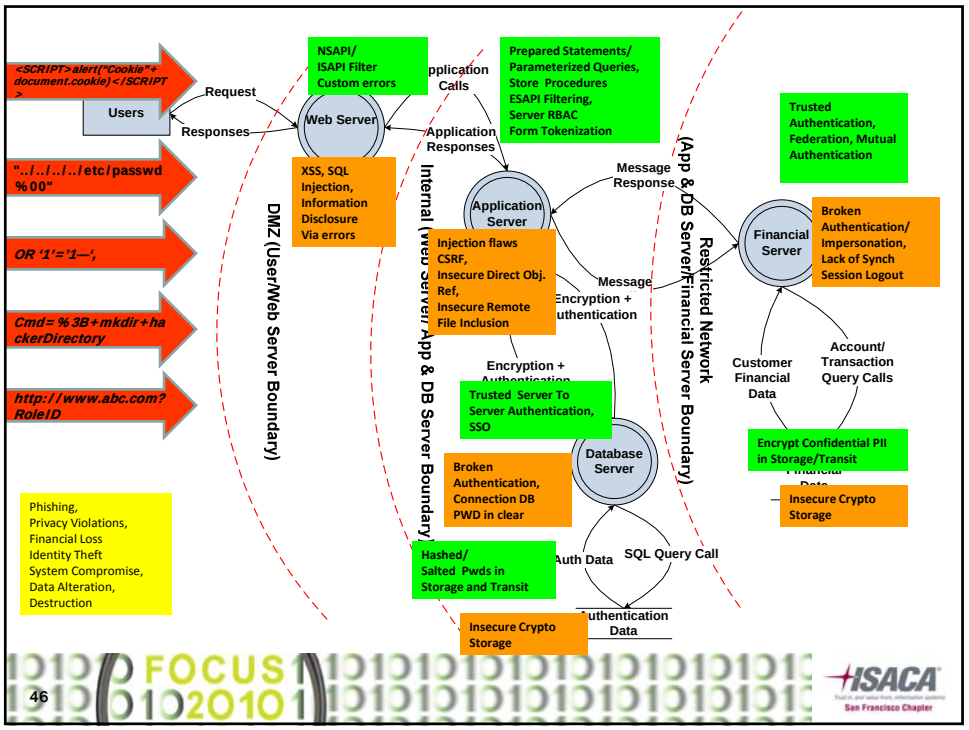
- Identify entry and exit points as well as related access levels
  - Internal and external interfaces
  - What are the trust boundaries?
  - Single/ Cross Domain traversals
  - Mapping out Networks

Exploits beget countermeasures

- Unacceptable risks give way to countermeasure development
- Develop countermeasures based upon the net risk of an application environment at multiple levels
  - Baseline configuration
  - Design and programmatic controls
  - 3rd party software/ COTS

Countermeasures

- Identify mitigations to the previously identified attacks-to-vuln relationship by locating the countermeasures
  - Native configuration countermeasures
  - ESAPI encryption (web.config)
  - TCP Wrappers
  - Mod Security
  - HTTPS/ HTTP validation
- Develop new countermeasures



Drivers & Value-Add

- Remediation takes place for risky findings
  - Understanding threats catalyzes remediation
- Abides by Building Security In concept
- Improves software assurance model
- Cost/ Time savings stem from time savings across multiple efforts
  - Chg Mgt, Post Implementation Security Testing, Exception Management

What does Risk mean anymore?

Do We Know Real Risk?

- Leaders have become desensitized to risk; its meaning has warped into opinionated thought exercises
  - Risk = ((Threats (probability) * Vulnerability)/Countermeasures) * Impact
  - Impact assumes threat will take place
  - Impact = # of occurrences * SLE
  - Occurrences may equate to incidents (records lost, number of servers, etc)
  - SLE = Exposure factor * Asset value

Why Management Doesn't Care

- Data rarely is relatable to business or operational impact
- Either too technical or too high level.
- Instead presents a laundry list of remediation items – more work!

Metrics, Research, & Threat Modeling

- Building Security In: A new risk modeling paradigm for developing applications
- Case & Point: Demonstrating how attack happen (pen test results, dynamic analysis, static analysis)
- Understanding Threats: Incorporates threat feeds, network traffic logs, intrusion attempts

Financial Incentives to Threat Modeling