Practical Approach For "Lightway" Threat Modeling Automation

Vitaly Davidoff

CISSP, CSSLP

DEEPSEC
IN-DEPTH SECURITY

Agenda

- What is Threat Modeling
- Existing Methodologies
- Problems in common solution
- Lightway Threat Modeling “As a Code”
- Risks Based Security Tests Orchestration
- CI/CD Overview
- Tools
- Things to warry about

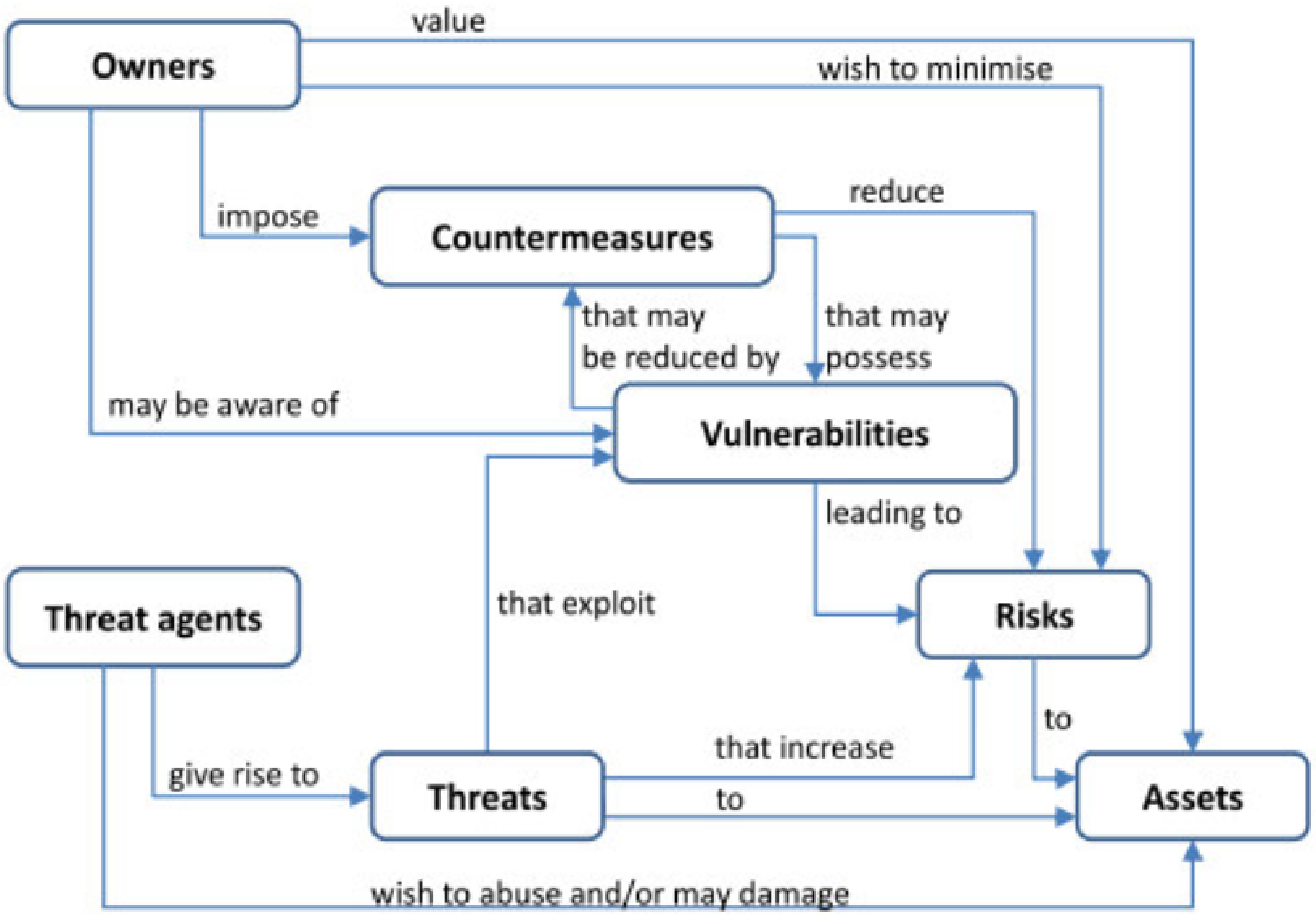
$WhoAmI

- AppSec Domain Lead at Citi Innovation Lab
- 15 years of experience as a developer
- 5+ years experience in application security
- Martial Arts instructor

Basic Security Terminology

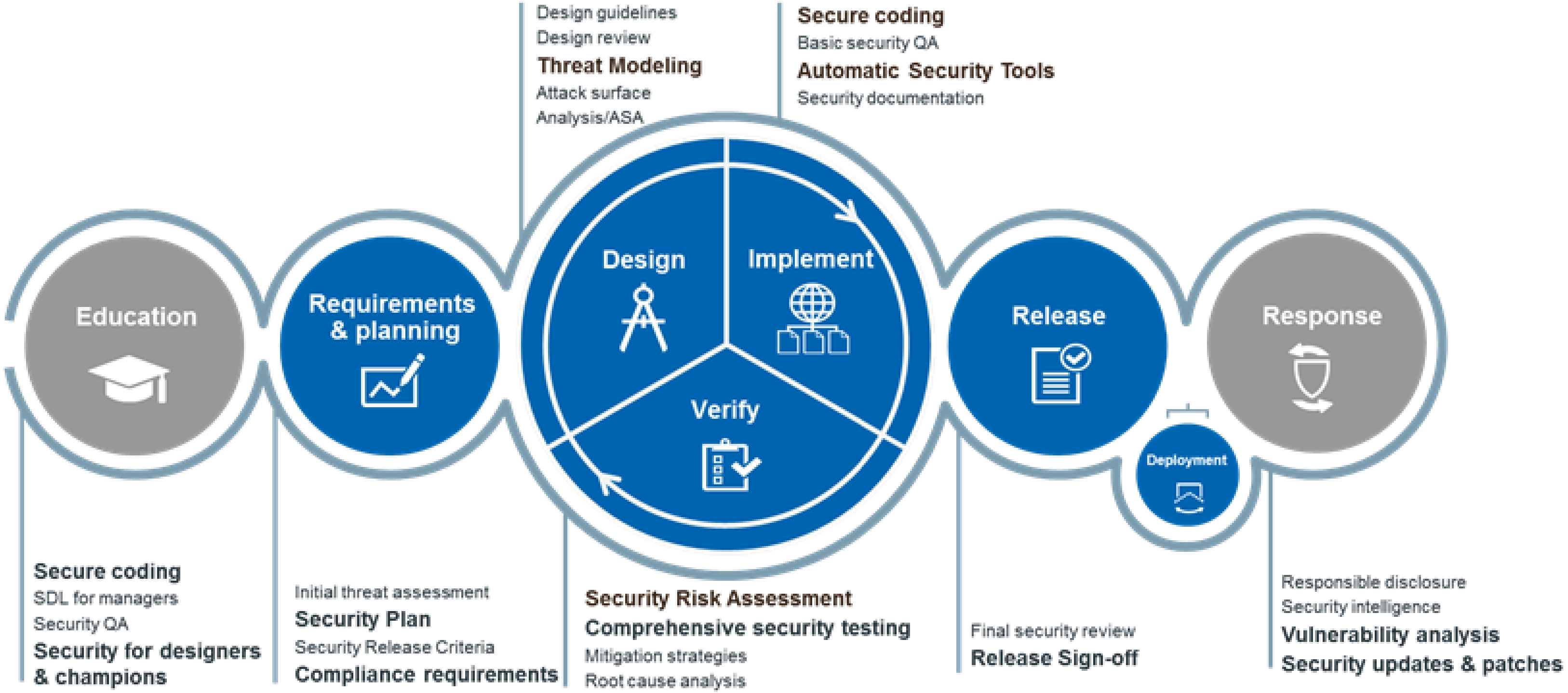
- Asset
- Threat
- Vulnerability
- Attack (or Exploit)
- Abuse Case
- Countermeasure (Security Control)
- Risk

Basic Security Terminology



Source: ISO 15408:2005

Secure SDLC Process



Education

Secure coding
SDL for managers
Security QA
Security for designers & champions

Requirements & planning

Initial threat assessment
Security Plan
Security Release Criteria
Compliance requirements

Design

Design guidelines
Design review
Threat Modeling
Attack surface Analysis/ASA

Implement

Secure coding
Basic security QA
Automatic Security Tools
Security documentation

Verify

Security Risk Assessment
Comprehensive security testing
Mitigation strategies
Root cause analysis

Release

Final security review
Release Sign-off

Deployment

Response

Responsible disclosure
Security intelligence
Vulnerability analysis
Security updates & patches

Source: MicroFocus

What Is Threat Modeling

- A powerful way to identify potentials threats, visualize risks and understand the security of the application
- A starting point to create robust security minded test plans
- The most reliable way to:
  - Understand the security implications of system architecture
  - Find business-process and system level security risks
  - Ensure you get the most impact for your security investment

Existing Methodologies

- **STRIDE**

  The STRIDE approach to threat modeling was introduced in 1999 at Microsoft, providing a mnemonic for developers to find 'threats to our products'.

- **PASTA**

  The Process for Attack Simulation and Threat Analysis (PASTA) is a seven-step, risk-centric methodology.

- **VAST**

  VAST is an acronym for Visual, Agile, and Simple Threat modeling. The underlying principle of this methodology is the necessity of scaling the threat modeling process across the infrastructure and entire SDLC, and integrating it seamlessly into an Agile software development methodology.

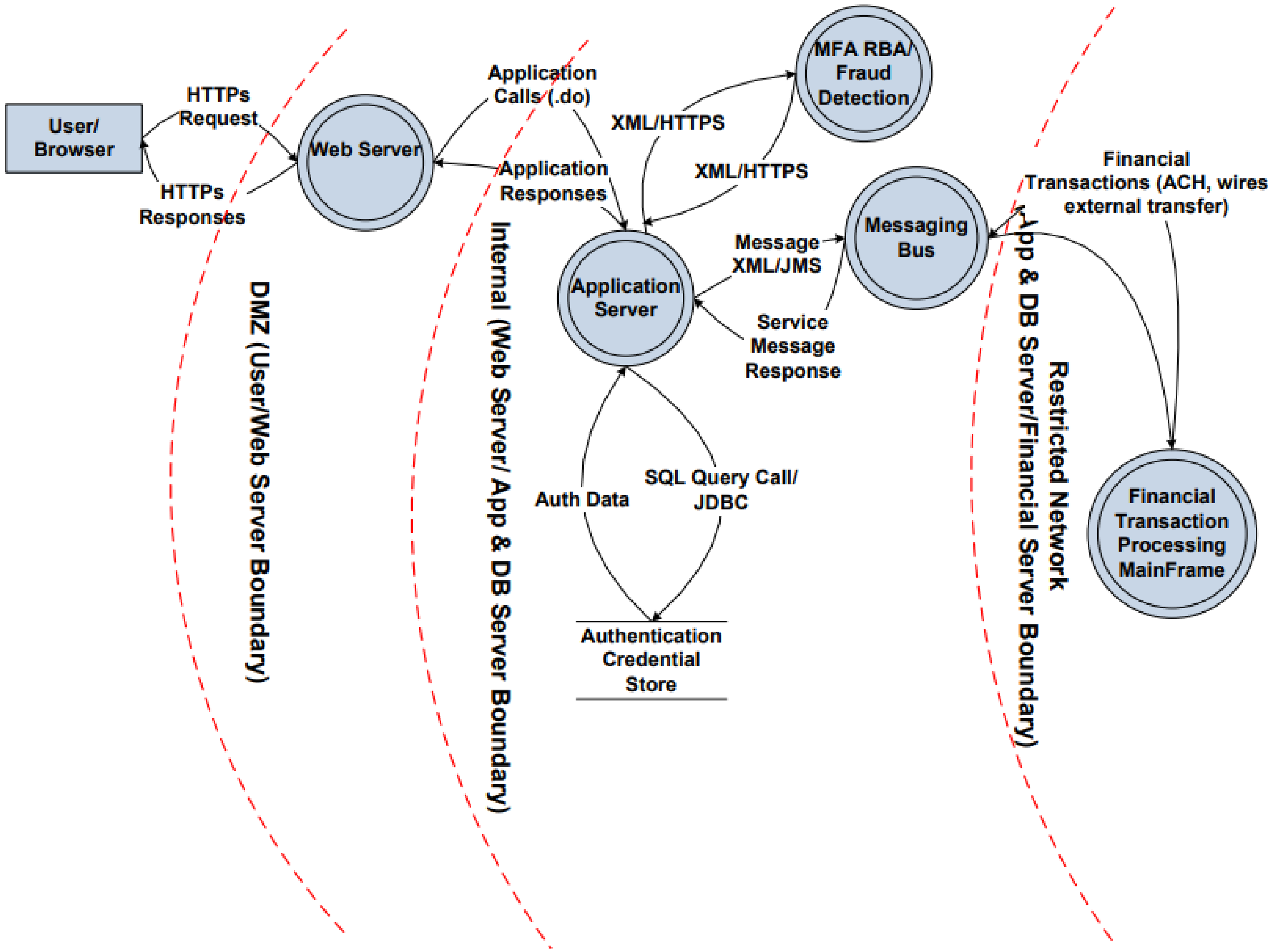
- **Trike**

  The focus of the Trike methodology is using threat models as a risk-management tool. Within this framework, threat models are used to satisfy the security auditing process.

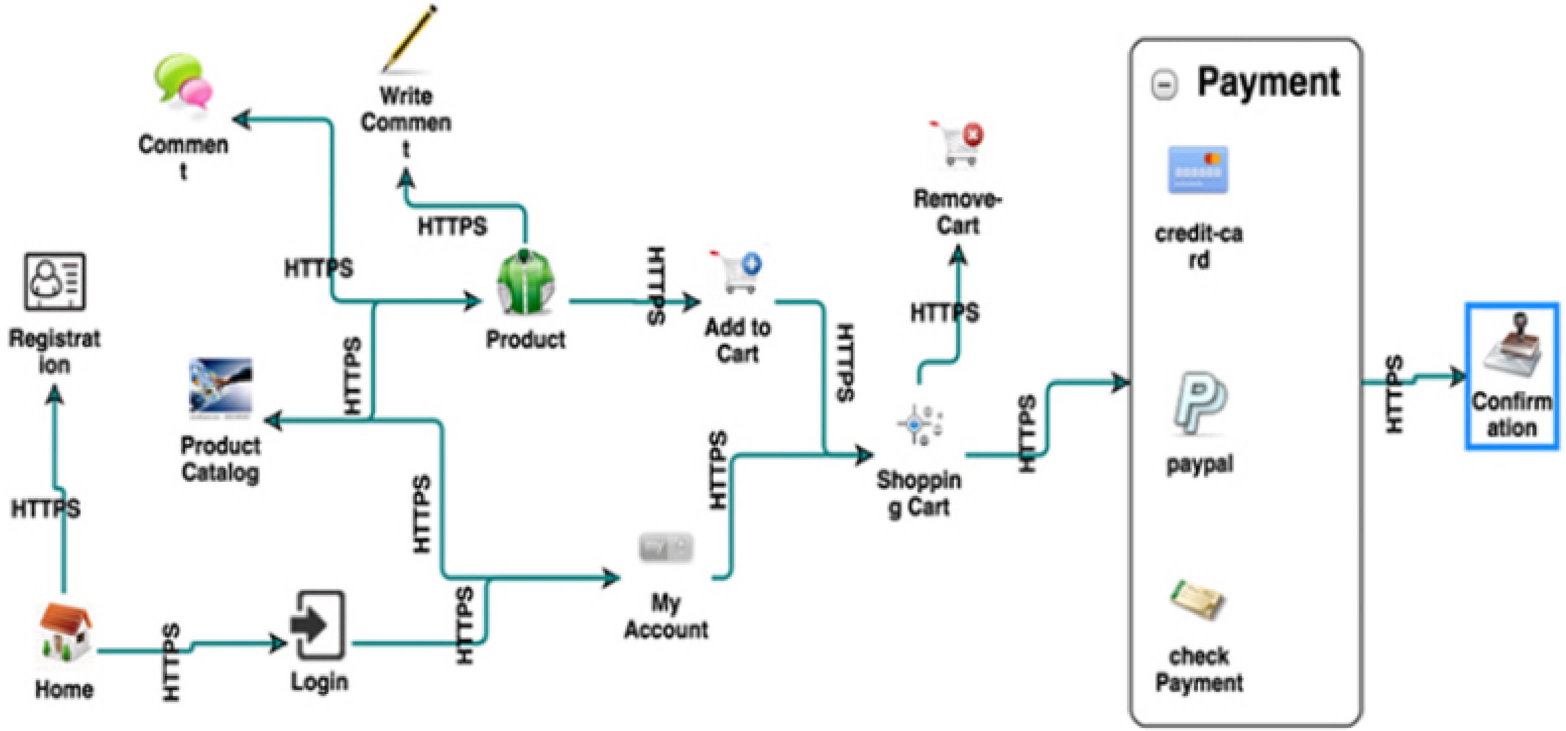
Threat Modeling Process

- What are we building?
  - “what are we working on, now, in this sprint/spike/feature?”
- What can go wrong?
- What are we going to do about that?
- Did we do a good enough job?

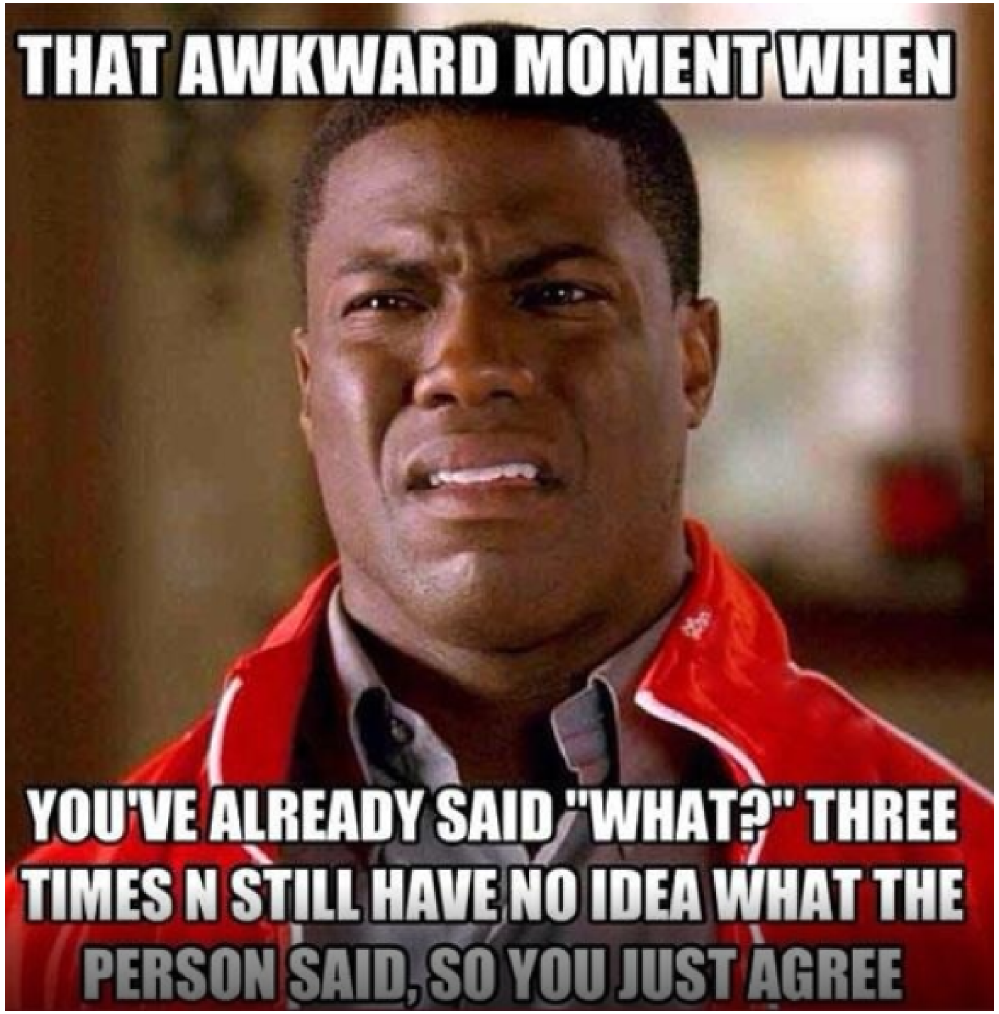
Data Flow Diagram (DFD)


User/ Browser
HTTPs Request
HTTPs Responses
Web Server
Application Calls (.do)
Application Responses
XML/HTTPS
XML/HTTPS
MFA RBA/ Fraud Detection
Application Server
Message XML/JMS
Service Message Response
Messaging Bus
Financial Transactions (ACH, wires external transfer)
Auth Data
SQL Query Call/ JDBC
Authentication Credential Store
Financial Transaction Processing MainFrame
DMZ (User/Web Server Boundary)
Internal (Web Server/ App & DB Server Boundary)
Restricted Network (App & DB Server/Financial Server Boundary)

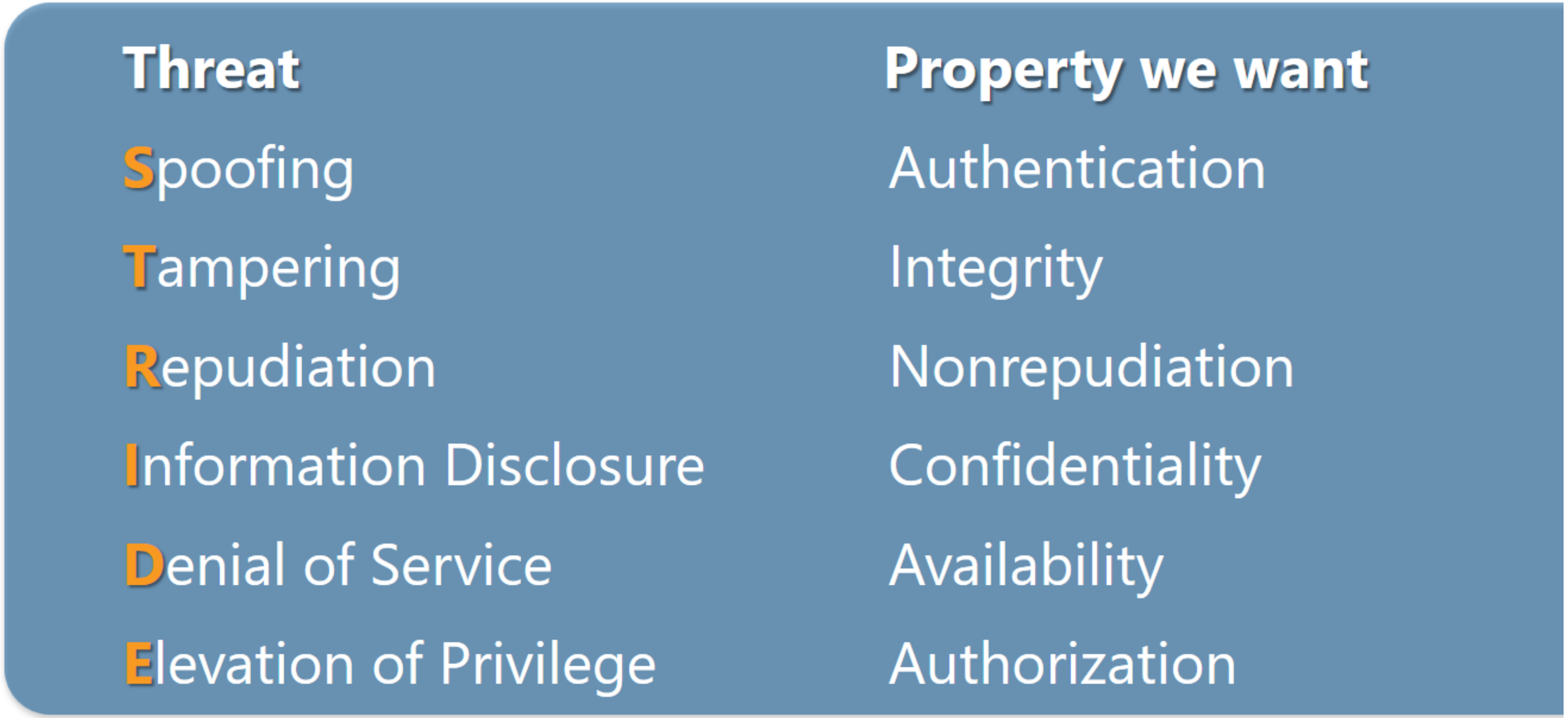
Process Flow Diagram (PFD)



“Think Like A Hacker!”

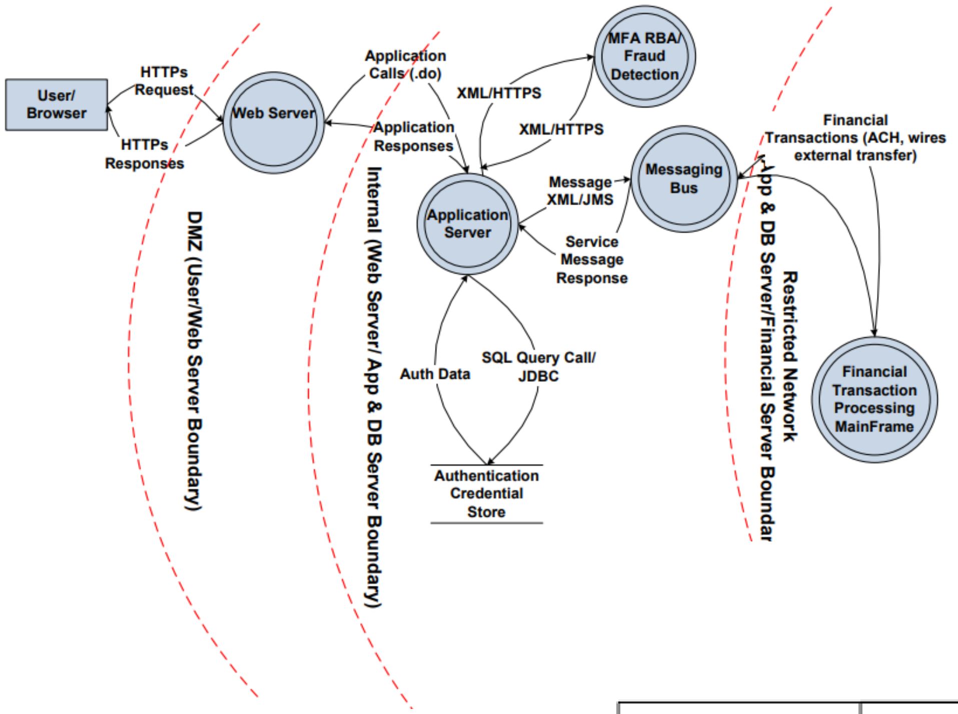

THAT AWKWARD MOMENT WHEN
YOU'VE ALREADY SAID "WHAT?" THREE TIMES N STILL HAVE NO IDEA WHAT THE PERSON SAID, SO YOU JUST AGREE

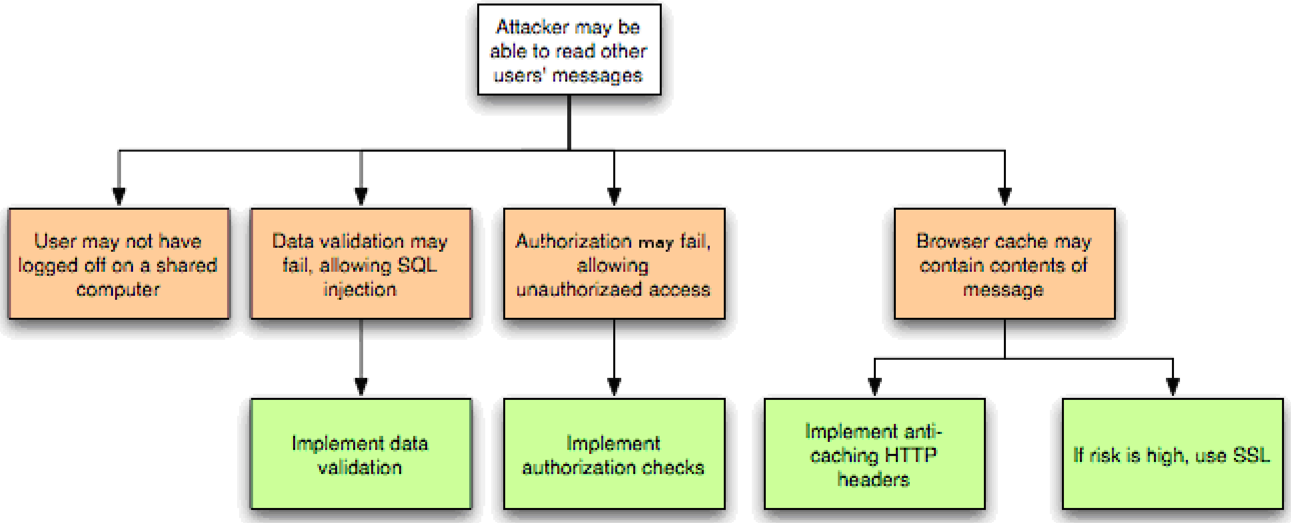
STRIDE – Identify Threats



Threat	Property we want
Spoofing	Authentication
Tampering	Integrity
Repudiation	Nonrepudiation
Information Disclosure	Confidentiality
Denial of Service	Availability
Elevation of Privilege	Authorization

DEEPSEC





Attacker may be able to read other users' messages

User may not have logged off on a shared computer

Data validation may fail, allowing SQL injection

Authorization may fail, allowing unauthorizaed access

Browser cache may contain contents of message

Implement data validation

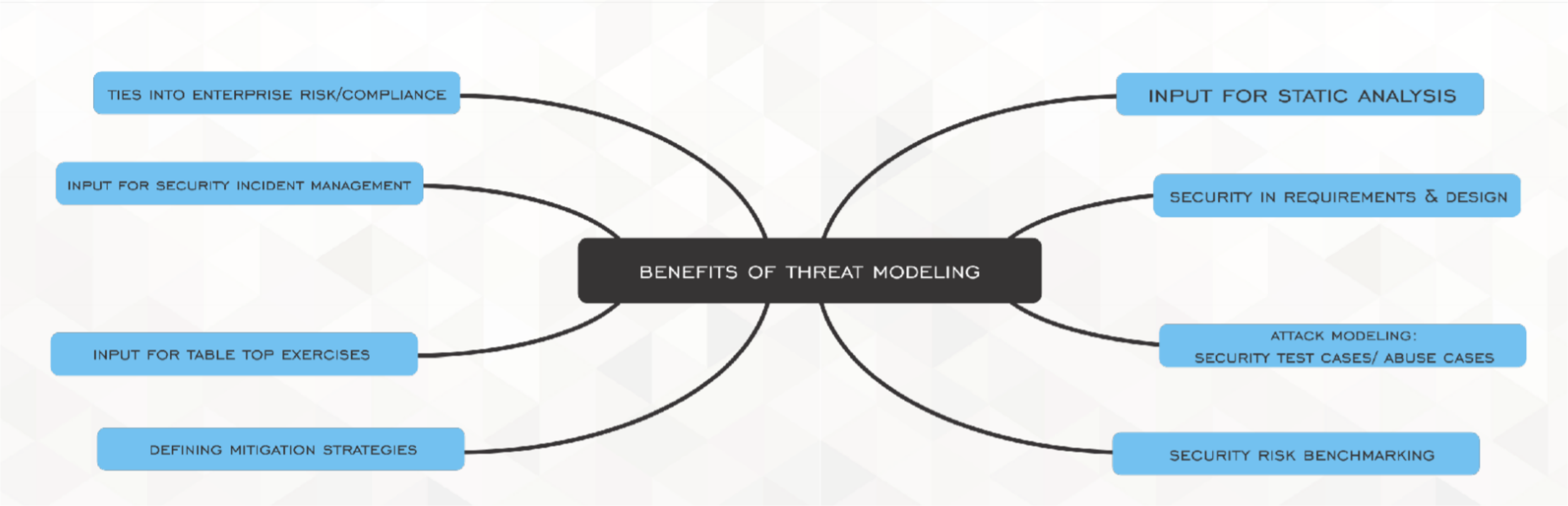
Implement authorization checks

Implement anti-caching HTTP headers

If risk is high, use SSL

Source: OWASP

Threat Modeling - Benefits

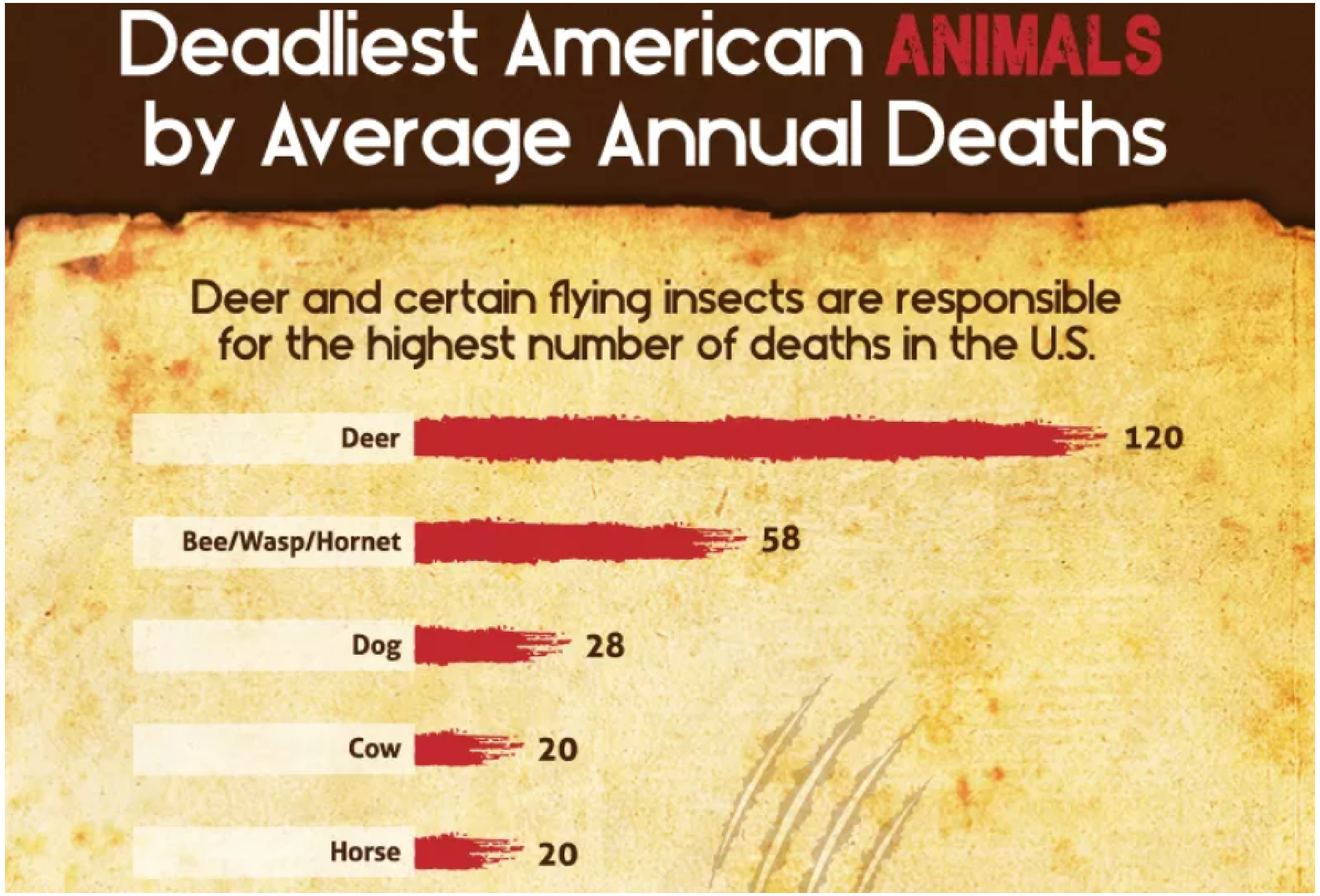


TIES INTO ENTERPRISE RISK/COMPLIANCE
INPUT FOR SECURITY INCIDENT MANAGEMENT
INPUT FOR TABLE TOP EXERCISES
DEFINING MITIGATION STRATEGIES
BENEFITS OF THREAT MODELING
INPUT FOR STATIC ANALYSIS
SECURITY IN REQUIREMENTS & DESIGN
ATTACK MODELING:
SECURITY TEST CASES/ ABUSE CASES
SECURITY RISK BENCHMARKING

Source: We45

A Note About “Intuitive” Security

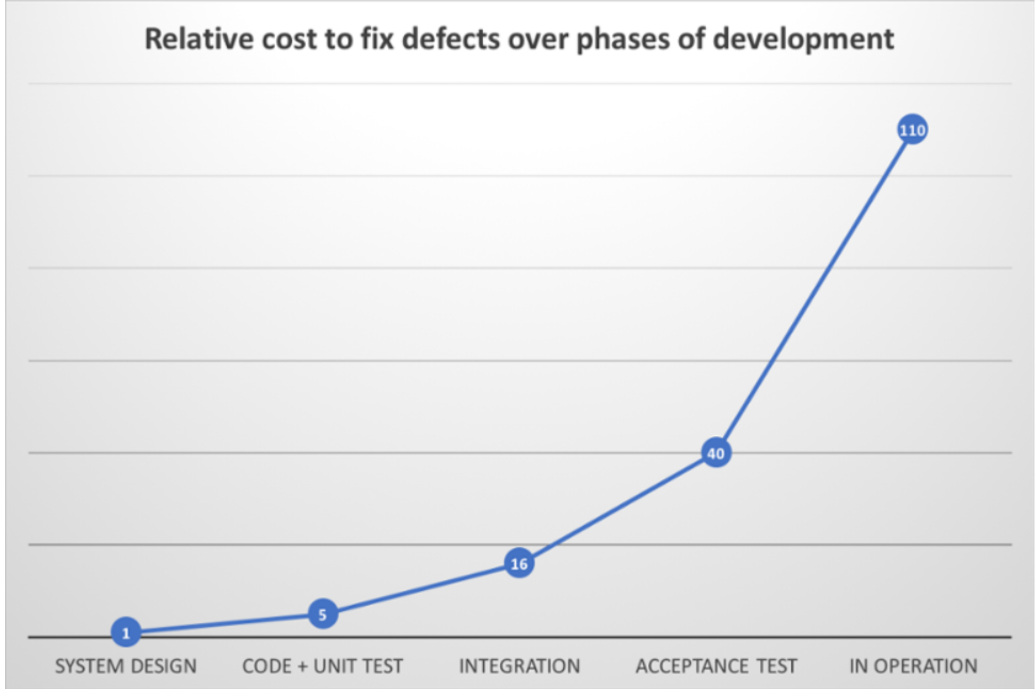
A Note About "Intuitive" Security



Threat Modeling And Secure SDLC

In simple words, at the early stages of the SDLC:

- Every time there is a change in the system's architecture.
- After a security incident has occurred or new vulnerabilities are introduced.
- As soon as the architecture is ready.



Threat Modeling - Responsibilities

- Architects
- **Security Specialists**
- Business Analysts
- Developers
- **Security Champions**

Common Problems

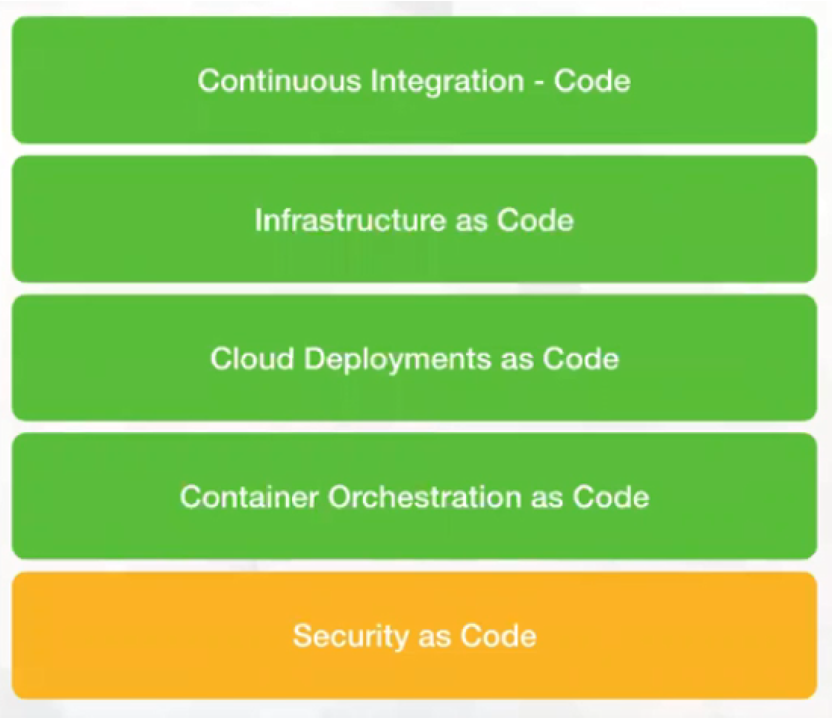
- Manual process, takes a lot of time
- Not propagated to Developers (in some cases, design defects opened)
- Updated on rare occasions (or not updates at all)
- Proceeded by security team (with very little help from R&D)
- Not integrated with DevOps model (CI/CD)
- Concentrated on Diagrams, not on countermeasures

"Agile and Microservices created a reality where Threat Modeling becomes a bottleneck - heavily resource intensive, requires a full team of expensive security professionals, takes up far too much time, and does not scalable…"

DevOps Automation

- Fosters speed
- Minimize human intervention
- Specification based frameworks
- Abstract the complexity away from the developer

✓ **Make everything as a Code!**



Continuous Integration - Code

Infrastructure as Code

Cloud Deployments as Code

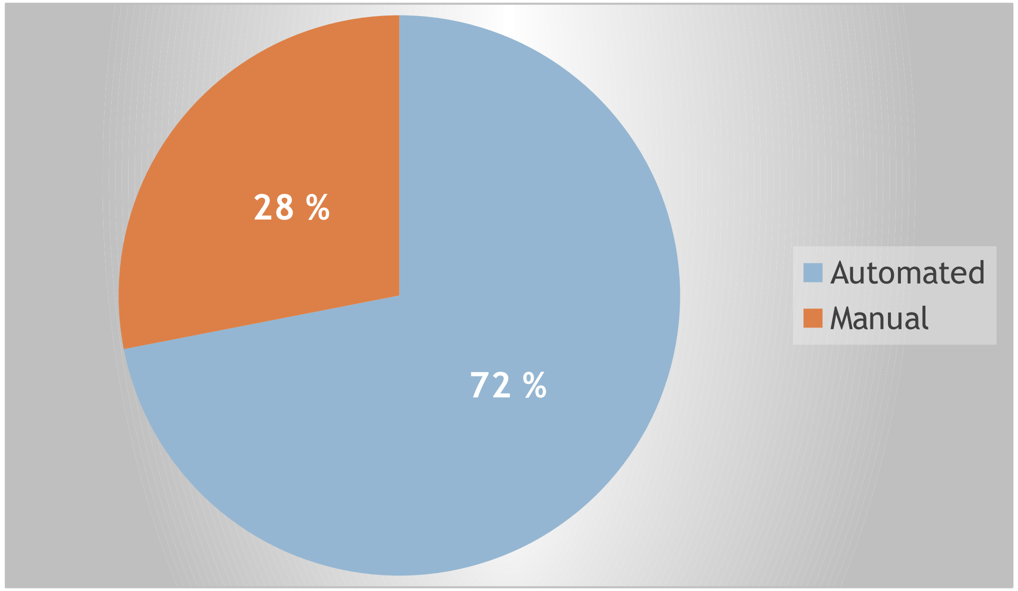
Container Orchestration as Code

Security as Code

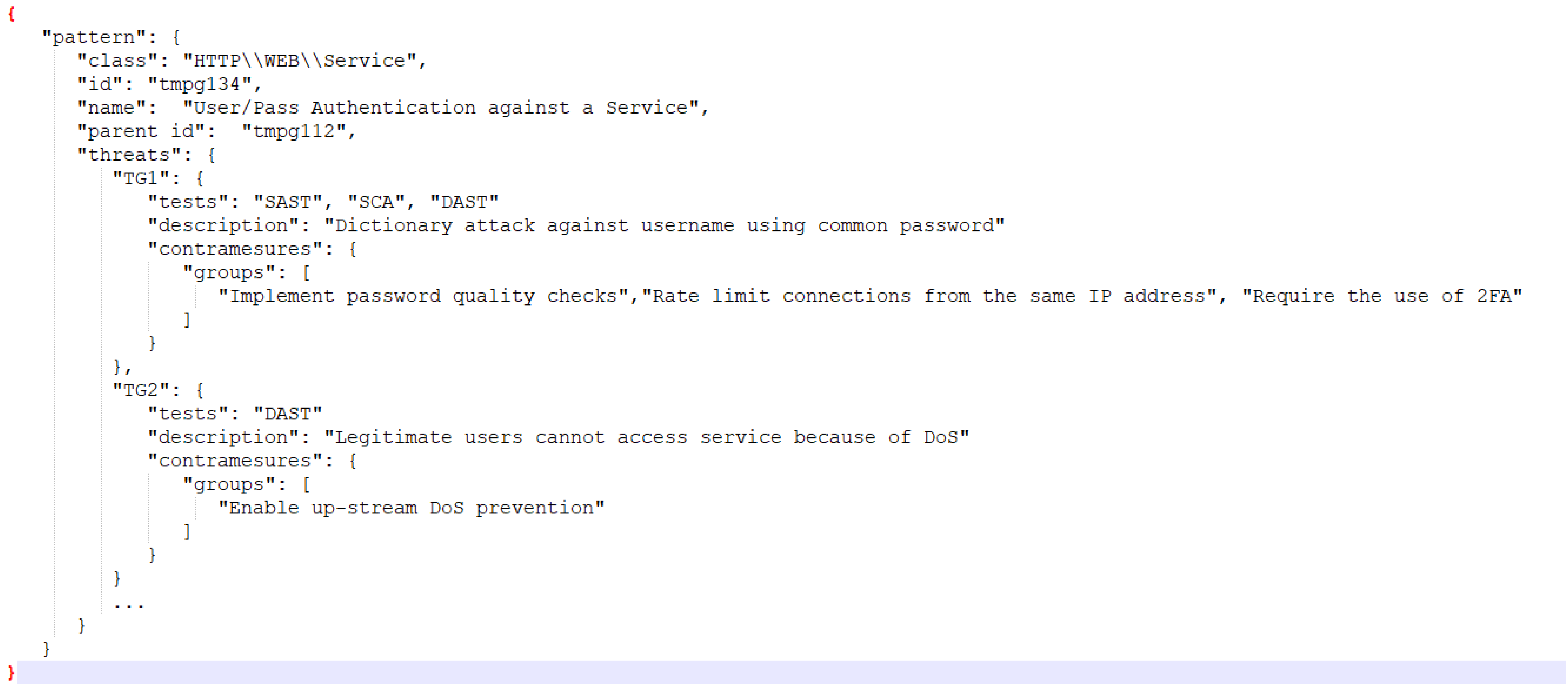
“Lightway” Threat Modeling As A Code

- CI/CD integration (security tests might be Threat Modeling based)
- Collaboration between different roles
- Iterative Threat Modeling
- Manageable Threat Modeling
- **Just enough Threat Modeling**

✓ **Let ~80% of Threat Modeling be automated!**



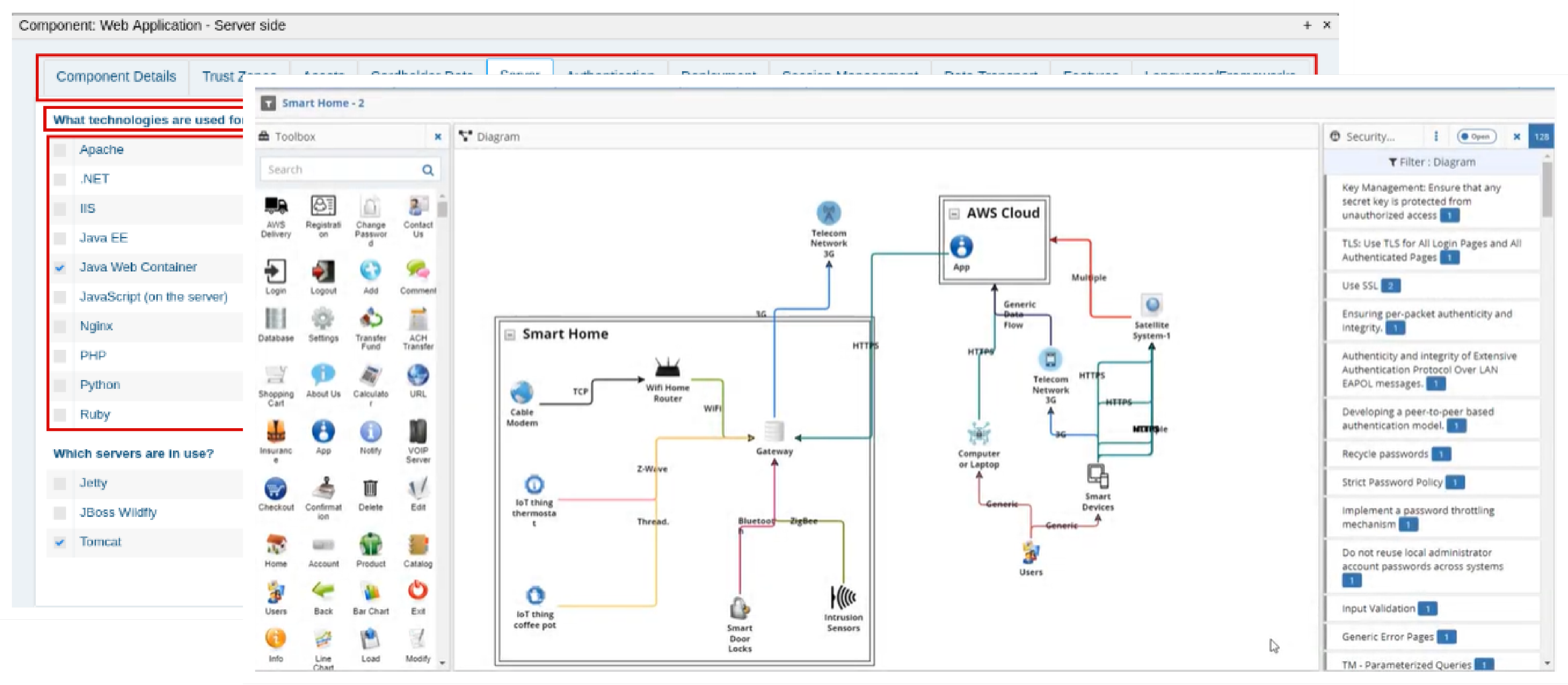
Step 1: Pattern* Definition (Example)



```
{
   "pattern": {
      "class": "HTTP\\WEB\\Service",
      "id": "tmpg134",
      "name":  "User/Pass Authentication against a Service",
      "parent id":   "tmpg112",
      "threats": {
         "TG1": {
            "tests": "SAST", "SCA", "DAST"
            "description": "Dictionary attack against username using common password"
            "contramesures": {
               "groups": [
                  "Implement password quality checks","Rate limit connections from the same IP address", "Require the use of 2FA"
               ]
            }
         },
         "TG2": {
            "tests": "DAST"
            "description": "Legitimate users cannot access service because of DoS"
            "contramesures": {
               "groups": [
                  "Enable up-stream DoS prevention"
               ]
            }
         }
         ...
      }
   }
}
```

* Stephen De Vries - Threat Modeling With Architectural Risk Patterns - AppSecUSA 2016

Patterns Selection



Component: Web Application - Server side

Component Details | Trust Z

What technologies are used fo

- □ Apache
- □ .NET
- □ IIS
- □ Java EE
- ☑ Java Web Container
- □ JavaScript (on the server)
- □ Nginx
- □ PHP
- □ Python
- □ Ruby

Which servers are in use?

- □ Jetty
- □ JBoss Wildfly
- ☑ Tomcat

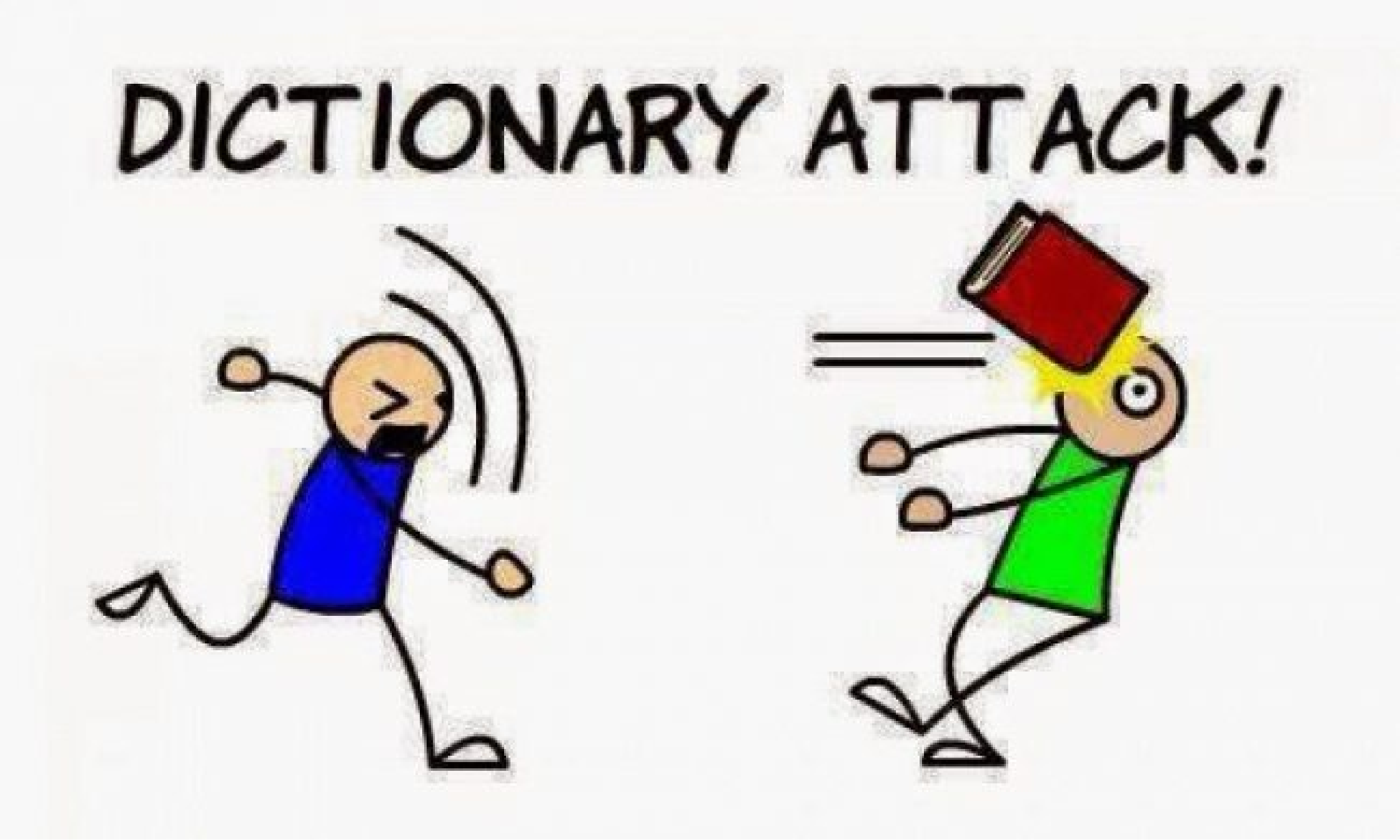
Smart Home - 2

Security... ● Open 128

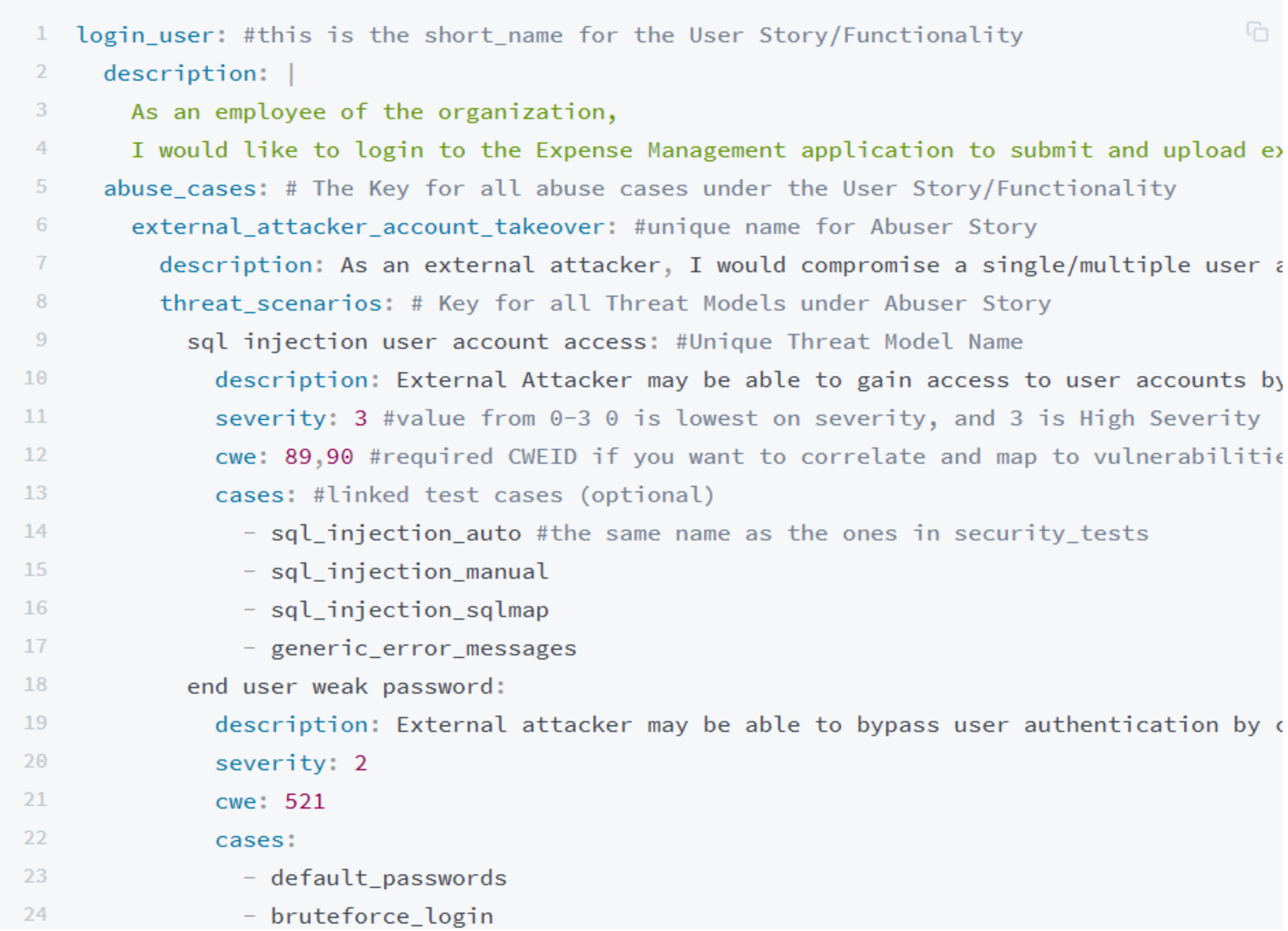
Filter : Diagram

- Key Management: Ensure that any secret key is protected from unauthorized access 1
- TLS: Use TLS for All Login Pages and All Authenticated Pages 1
- Use SSL 2
- Ensuring per-packet authenticity and integrity. 1
- Authenticity and integrity of Extensive Authentication Protocol Over LAN EAPOL messages. 1
- Developing a peer-to-peer based authentication model. 1
- Recycle passwords 1
- Strict Password Policy 1
- Implement a password throttling mechanism 1
- Do not reuse local administrator account passwords across systems 1
- Input Validation 1
- Generic Error Pages 1
- TM - Parameterized Queries 1

From The Developer’s Point Of View



Step 2: Threat Modeling YAML File



```yaml
login_user: #this is the short_name for the User Story/Functionality
  description: |
    As an employee of the organization,
    I would like to login to the Expense Management application to submit and upload ex
  abuse_cases: # The Key for all abuse cases under the User Story/Functionality
    external_attacker_account_takeover: #unique name for Abuser Story
      description: As an external attacker, I would compromise a single/multiple user a
      threat_scenarios: # Key for all Threat Models under Abuser Story
        sql injection user account access: #Unique Threat Model Name
          description: External Attacker may be able to gain access to user accounts by
          severity: 3 #value from 0-3 0 is lowest on severity, and 3 is High Severity
          cwe: 89,90 #required CWEID if you want to correlate and map to vulnerabilitie
          cases: #linked test cases (optional)
            - sql_injection_auto #the same name as the ones in security_tests
            - sql_injection_manual
            - sql_injection_sqlmap
            - generic_error_messages
        end user weak password:
          description: External attacker may be able to bypass user authentication by c
          severity: 2
          cwe: 521
          cases:
            - default_passwords
            - bruteforce_login
```

Source: ThreatPlaybook

Step 3: Risk Based Security Test Orchestration

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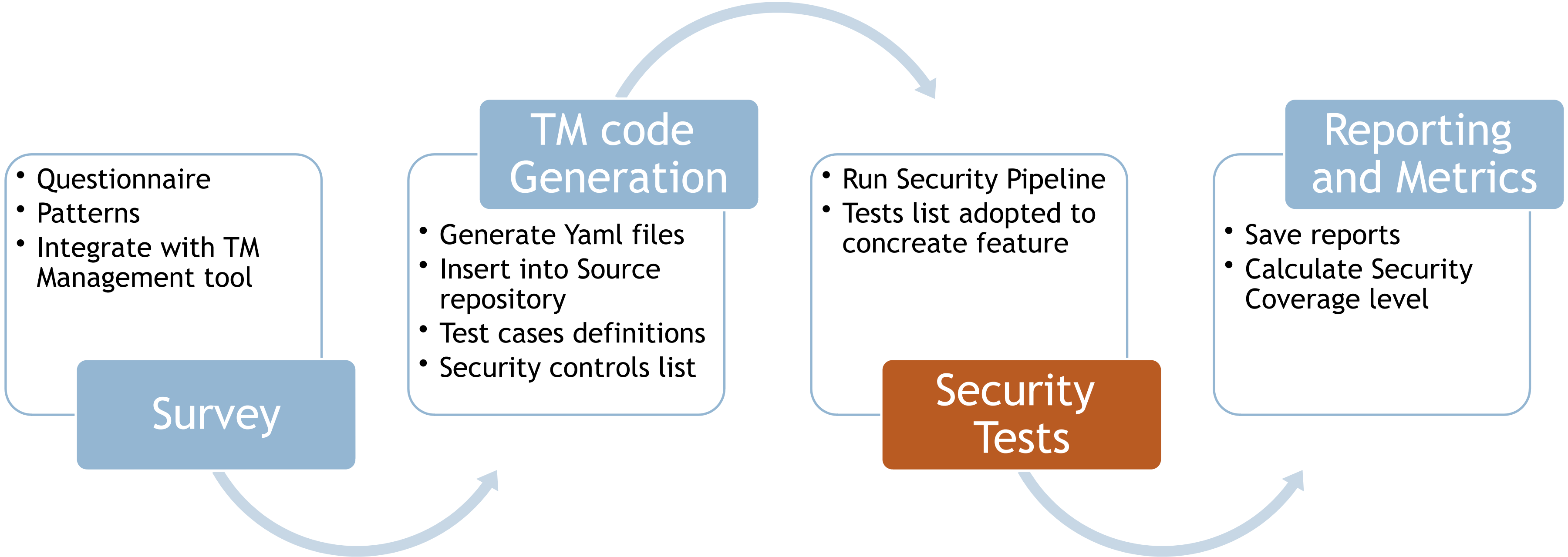


Survey

- Questionnaire
- Patterns
- Integrate with TM Management tool

TM code Generation

- Generate Yaml files
- Insert into Source repository
- Test cases definitions
- Security controls list

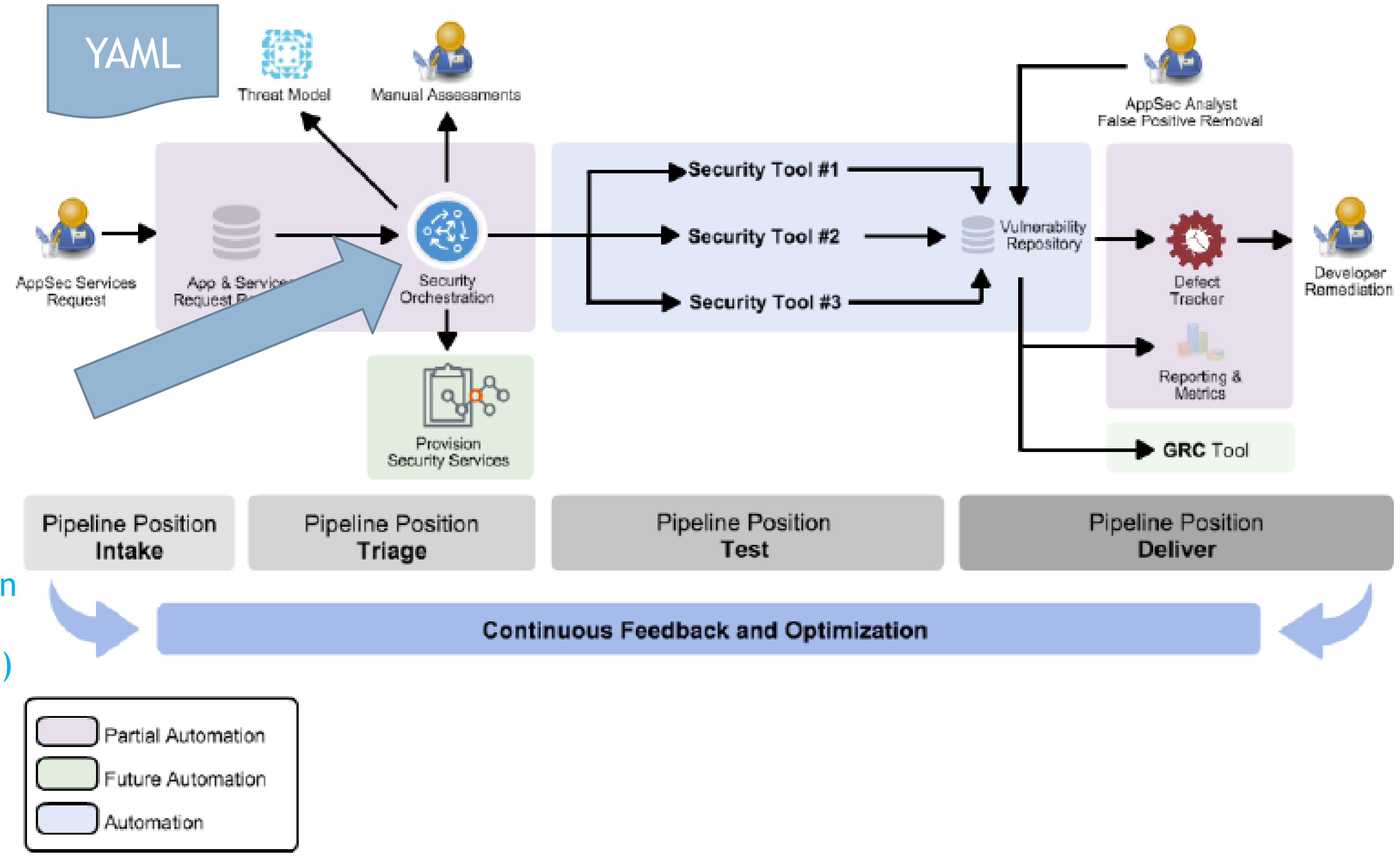
Security Tests

- Run Security Pipeline
- Tests list adopted to concreate feature

Reporting and Metrics

- Save reports
- Calculate Security Coverage level

Rugged Devops - AppSec Pipeline Template



Aaron Weaver, CC ShareAlike 3.0

- ✓ Deploy stage will run parallel Security Test pipeline (Asynchronies)

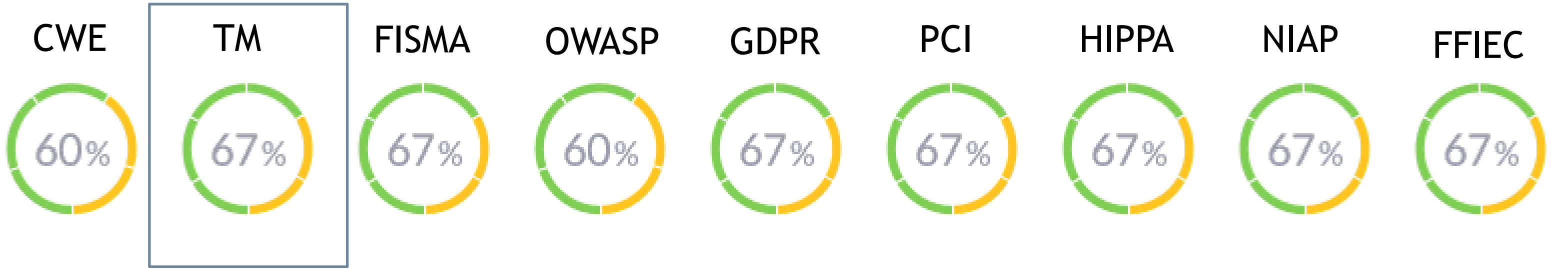
- ✓ Approval Gate will check Security Test coverage and automatically approve push to production if security criteria achieved

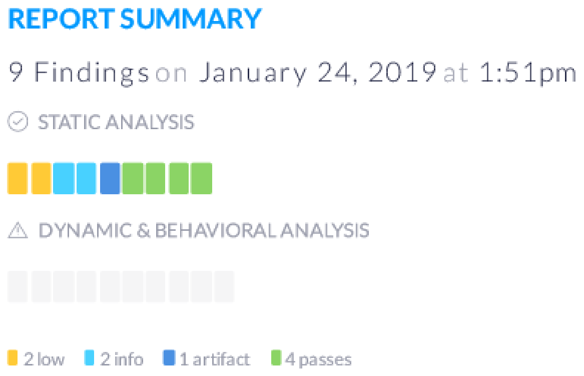
Step 4: CI/CD Integration (Example)

- Process will be triggered by “Security Test” step as part of Build stage
  - Pull Threat Modeling process from Git (If not exists – process will be stopped! As a Gate)
  - Run Security test pipeline (as parallel to functional pipeline)
- During any “final” stage (post-functional tests)
  - Validate if security tests flow finished
  - Check security coverage (As a Gate)
  - If vulnerabilities found – open tickets inside defect management system (Jira)
- During release approve stage
  - **Automatically approve!** If has a good coverage and suitable vulnerabilities score
  - Manual approve only need if security thresholds violated

Coverage Review

- Coverage calculated by automation tool
- Ticket should be opened automatically with all context needed
- Report contains all tests and findings in relation to Threat Modeling use cases




REPORT SUMMARY

9 Findings on January 24, 2019 at 1:51pm

STATIC ANALYSIS

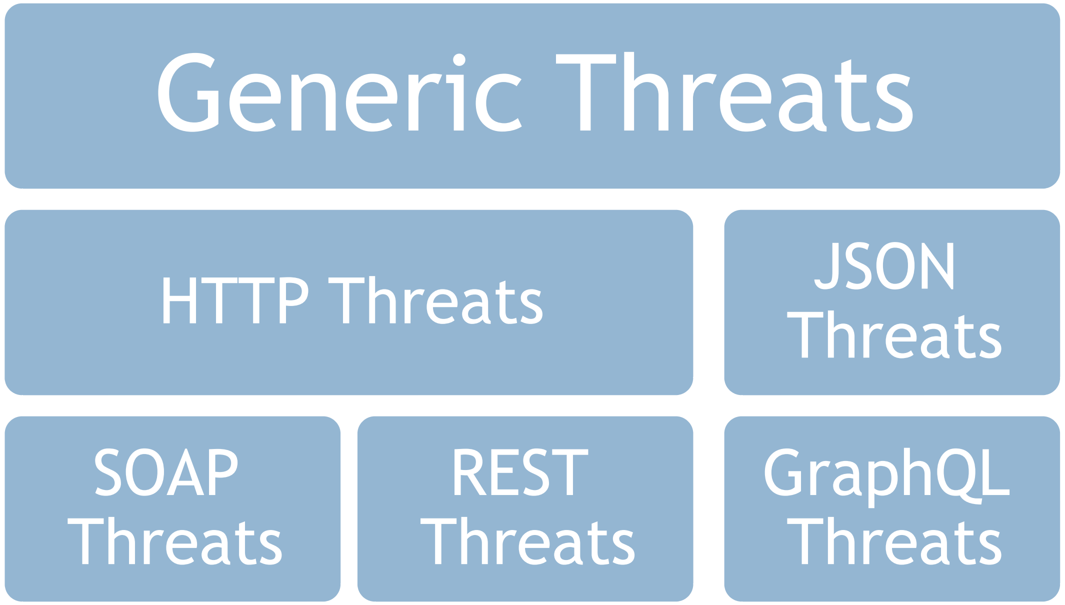
DYNAMIC & BEHAVIORAL ANALYSIS

🟨 2 low 🟦 2 info 🟦 1 artifact 🟩 4 passes

Main Points (Summary)

- Based on OWASP ASVS v2 or other standards
- Part of feature onboarding
- Responsibility moved to R&D
- Integrated part of CI/CD flow
- Managed by security specialists

✓ **Template based approach!**



Generic Threats

HTTP Threats

JSON Threats

SOAP Threats

REST Threats

GraphQL Threats

Thinks To Warry About

- Scope – Feature/User story
- **No single framework exists**
- **No Threat Modeling orchestration specification**
- Evaluation plan (synchronies vs asynchronies)
- **Integrate manual Threat Modeling process be part of orchestration**

Toolset (Example)

- ChatOps Slak – Uses as semi-automated check list questioner
- ThreatPlaybook – Automation for Threat Modeling process and documents
- ThreatModeler – Threats generation based on DFD’s
- Jenkins – CI/CD pipeline or Security Pipeline
- Robot – Security Pipeline
- BDD – Security Test (behavior driven)
- Jira – Features and Defects Management system
- IriusRisk – Management framework and Threat Modeling automation
- Orchestron – Management Tool
- Security Compass – Management Tool
- ZeroNorth – tests orchestrator and reports management system

Thank You!

vitaly.davidoff@citi.com

LinkedIn: https://www.linkedin.com/in/vitaly-davidoff-07039a1