Threat Modeling

OWASP Hartford

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Robert Hurlbut

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Robert Hurlbut

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- **Independent Software Security Consultant and Trainer**
  - Owner / President of Robert Hurlbut Consulting Services
  - Microsoft MVP – Security Developer 2005-2009, 2015
  - (ISC)2 CSSLP 2014-2017
  - Group Leader – Boston .NET Arch Group, Amherst Sec Grp
  - Speaker at user groups, conferences, and other events

- **Contacts**
  - Web Site: https://roberthurlbut.com/
  - LinkedIn: https://www.linkedin.com/in/roberthurlbut/
  - Twitter: @RobertHurlbut
  - Email: robert at roberthurlbut.com
  - Slides Location: https://roberthurlbut.com/training/presentations

What is threat modeling?

Something we all do in our personal lives …

… when we lock our doors to our house

… when we lock the windows

… when we lock the doors to our car

We threat model by thinking ahead of what could go wrong and acting accordingly

What is threat modeling?

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Threat modeling is the process of understanding your system and potential threats against your system.

A threat model helps you assess the probability, potential harm, and priority of threats.

Based on the model you can try to minimize or eradicate the threats.

Michael Howard @michael_howard Jan 7, 2015

A dev team with an awesome, complete and accurate threat model gets my admiration and not much of my time because they don't need it! ☺

Brook Schoenfield @BrkSchoenfield June 29, 2015

> *As I practice it, threat modeling cannot be the province of a tech elite. It is best owned by all of a development team.*

Threat modeling helps you …

Identify threats your system faces

Challenge assumptions

Prioritize other security efforts (pen test, review, fuzzing)

Document what you have learned

Definitions

Threat Agent

- Someone (or a process) who could do harm to a system (also adversary or attacker)

Definitions

Threat

An adversary’s goal

Definitions

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Vulnerability

A flaw in the system that could help a threat agent realize a threat

Definitions

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Attack

When a motivated and sufficiently skilled threat agent takes advantage of a vulnerability

Definitions

Asset

Something of value to valid users and adversaries alike

When?

Make threat modeling part of your secure software and architecture design

What if I didn’t? It’s not too late to start threat modeling, but it will be more difficult to change major design decisions

Getting started

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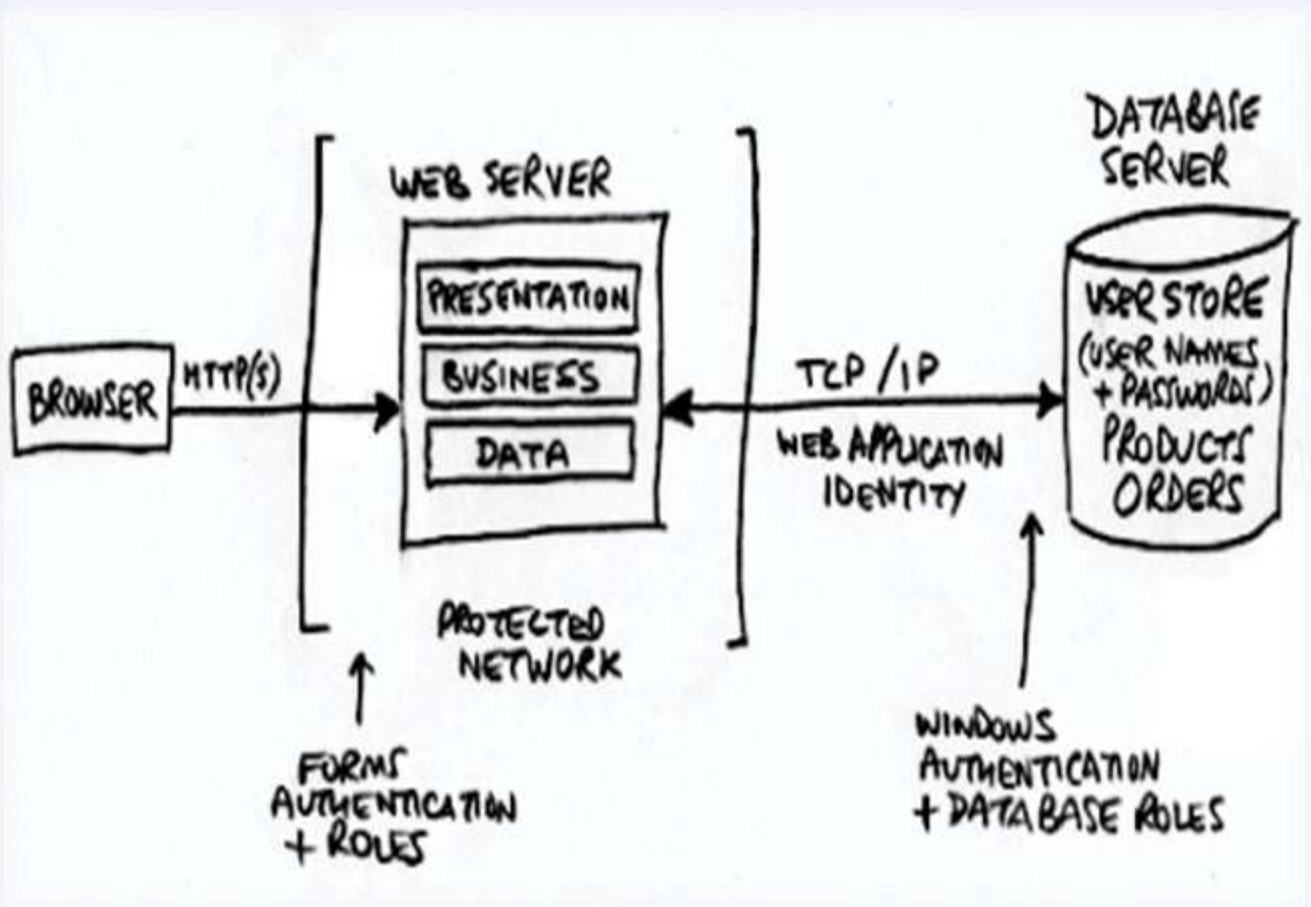
- Gather documentation (requirements, high-level design, detailed design, etc.)
- Gather your team (don’t make this one person’s job only!)
  - Developers, QA, Architects, Project Managers, Business Stakeholders
- Understand business goals
- Understand technical goals
- Agree on meeting date(s) and time(s)
- Plan on 1-2 hours at a time spread over a week or weeks – keep sessions focused
- **Important:** Be honest, leave ego at the door, no blaming!

Threat Modeling Process – Making it work

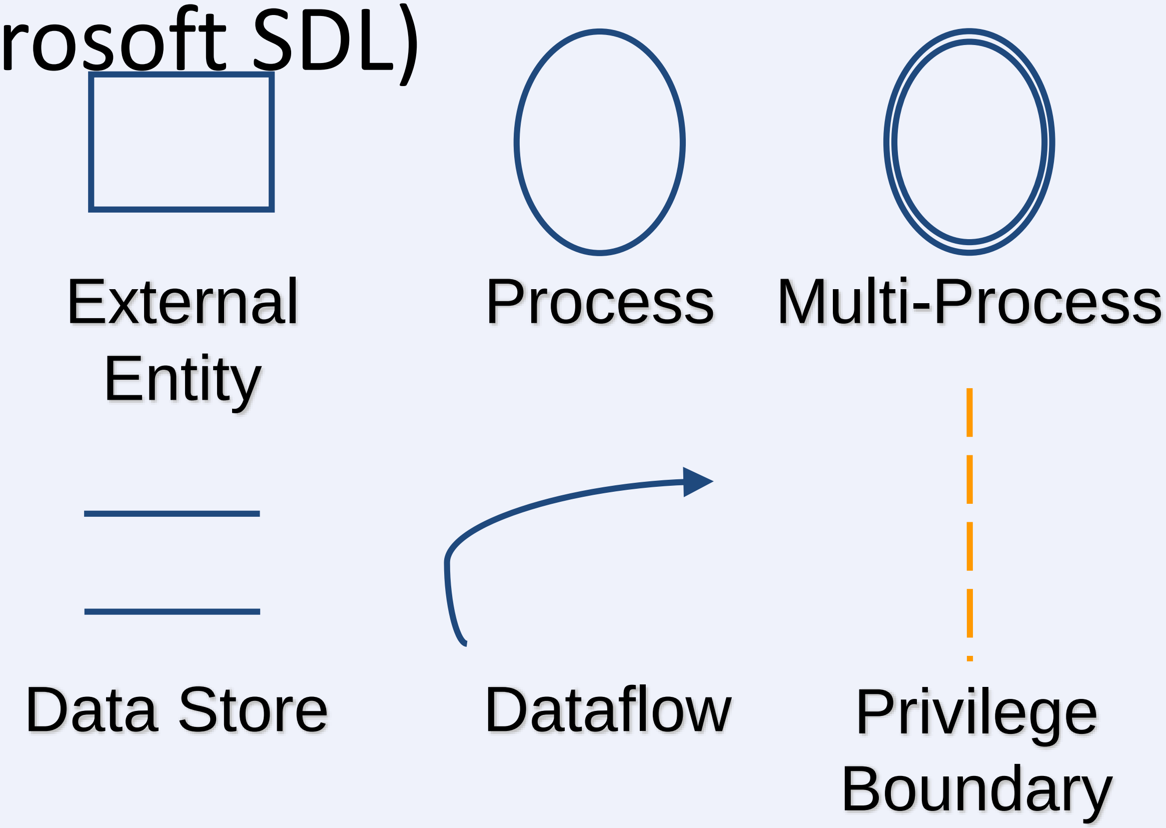
1. Draw your picture - model the system
2. List the elements – entities, processes, data, data flows
3. Identity the threats - Ask questions
4. Determine mitigations and risks
5. Follow through

Draw your picture



Model the system

- DFD – Data Flow Diagrams (from Microsoft SDL)



External Entity

Process

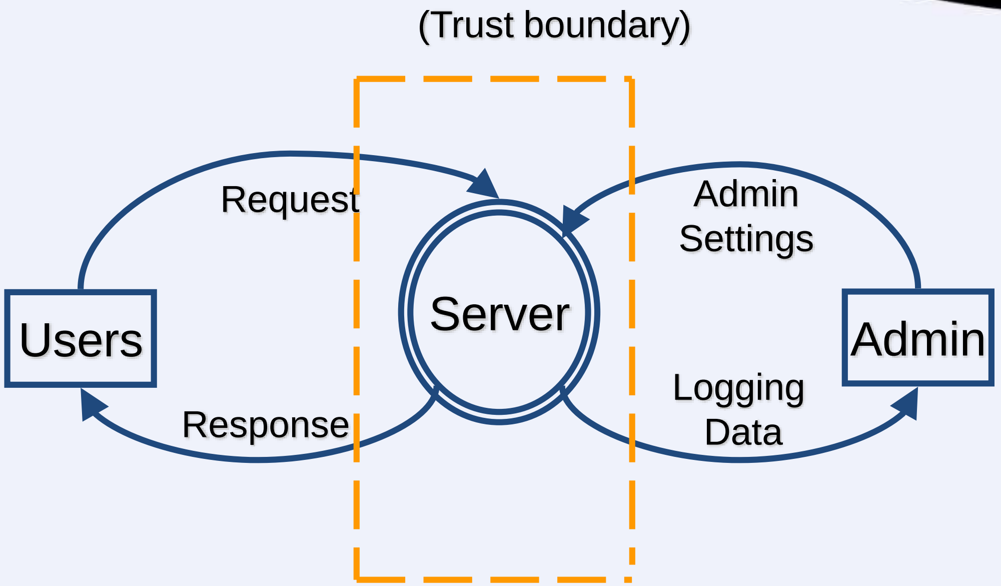
Multi-Process

Data Store

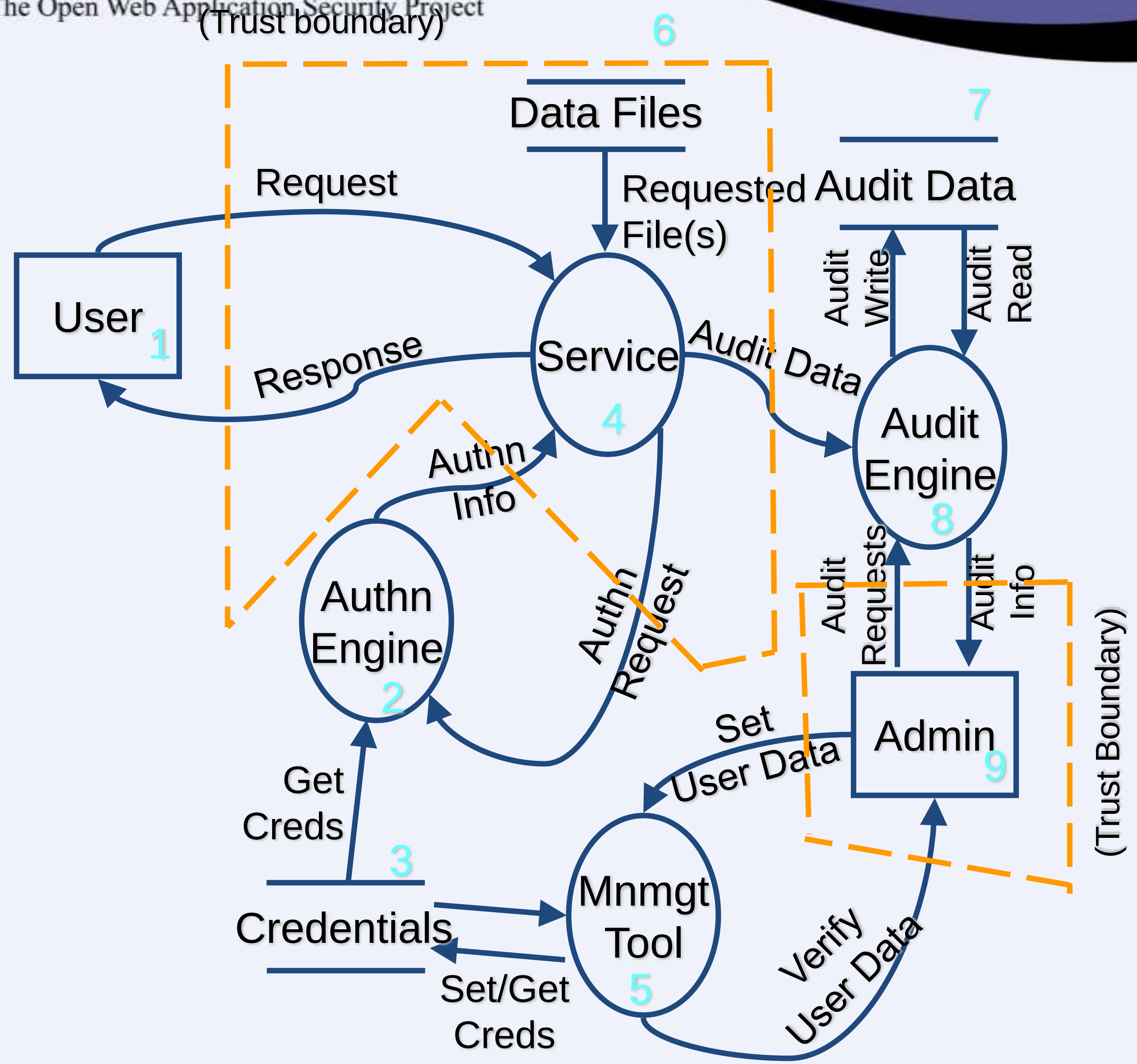
Dataflow

Privilege Boundary

Model the System



Model the system



Your threat model now consists of …

1. Diagram / visual model of your system

Identity the elements

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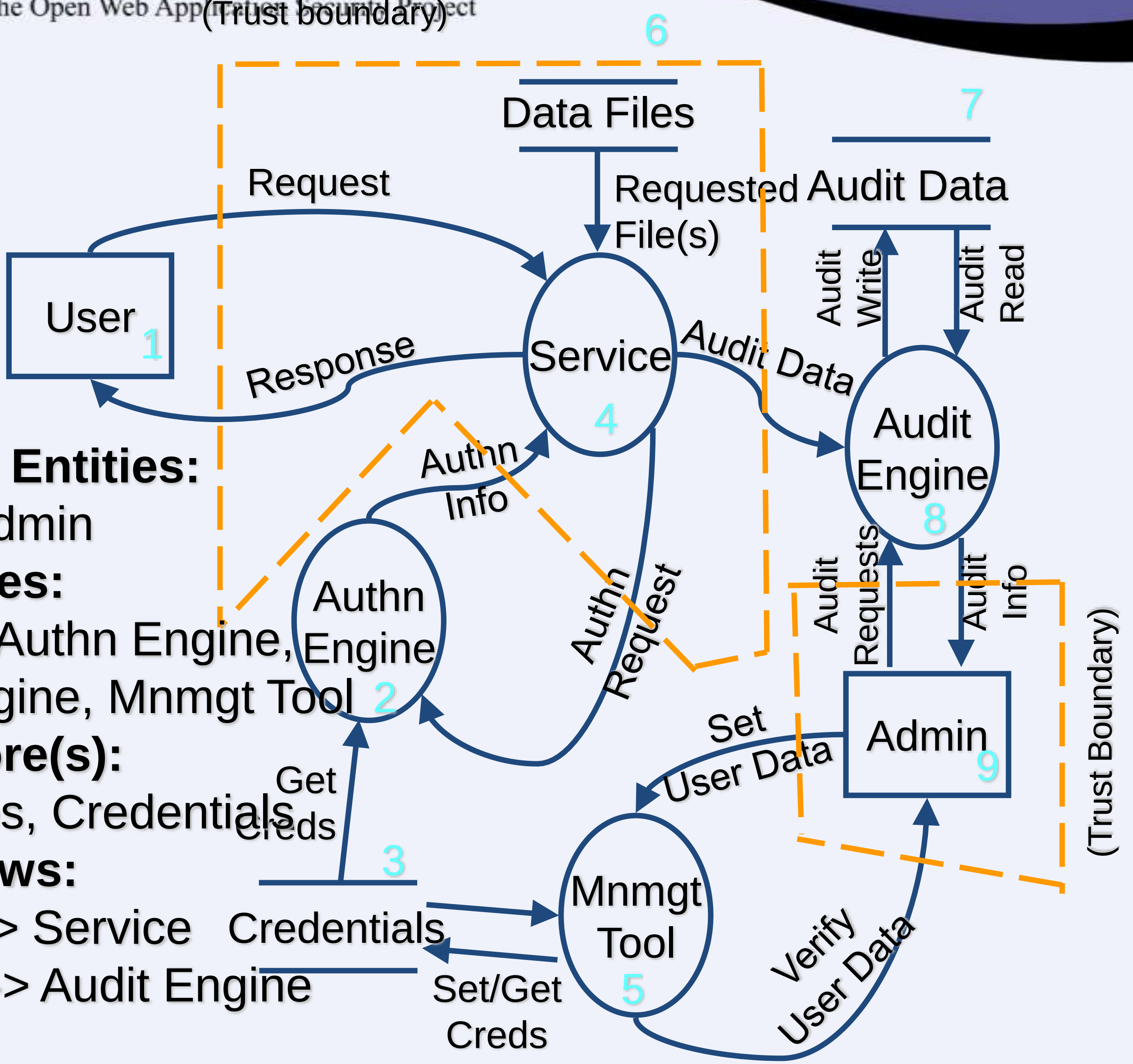

External Entities:
Users, Admin
Processes:
Service, Authn Engine,
Audit Engine, Mnmgt Tool
Data Store(s):
Data Files, Credentials
Data Flows:
Users <-> Service
Admin <-> Audit Engine

Your threat model now consists of …

1. Diagram / visual model of your system
2. Elements of your system and the interactions

Identify threats

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Attack Trees (Bruce Schneier - Slidedeck)

Threat Libraries (CAPEC, OWASP Top 10, SANS Top 25)

Checklists (ex: OWASP Application Security Verification Standard (ASVS), OWASP Proactive Controls 2016))

Use Cases / Misuse Cases

Identify threats

Games:

Elevation of Privilege (EoP)

OWASP Cornucopia

OWASP Cornucopia

Suits:

Data validation and encoding

Authentication

Session Management

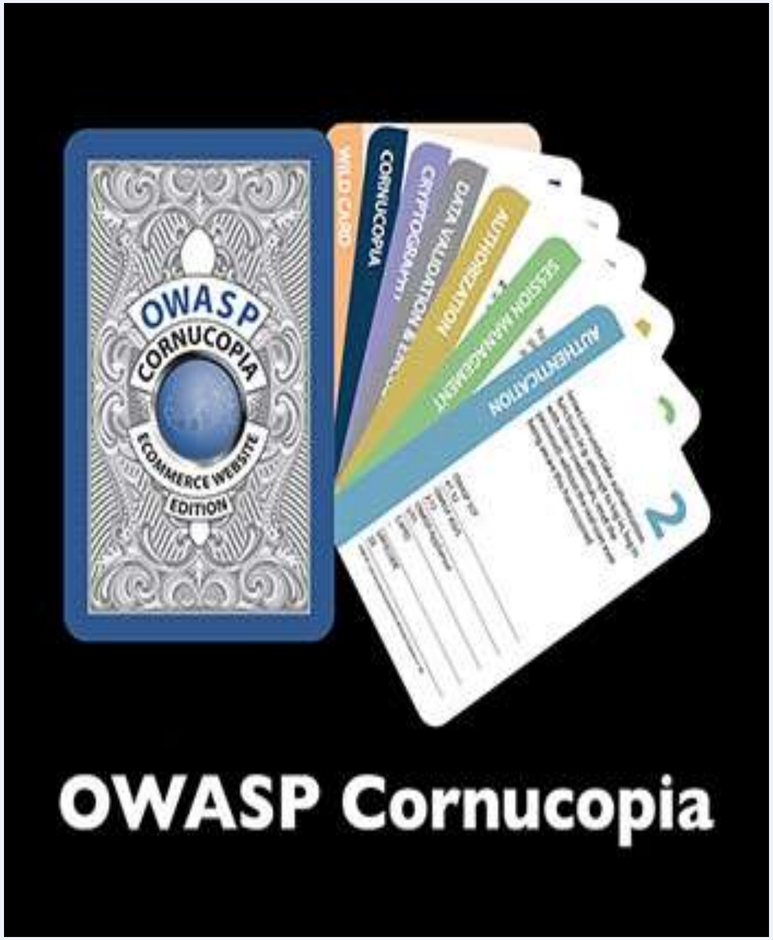
Authorization

Cryptography

Cornucopia

13 cards per suit, 2 Jokers

Play a round, highest value wins



STRIDE Framework* for finding threats

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

* Framework, not classification scheme. STRIDE is a good framework, bad taxonomy

Identify threats

P.A.S.T.A. – Process for Attack Simulation and Threat Analysis

7 step process combining:

STRIDE + Attacks + Risk Analyses

Identify Threats

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Input and data validation
Authentication
Authorization
Configuration management
Sensitive data
Session management
Cryptography
Parameter manipulation
Exception management
Auditing and logging

Ask questions

How is authentication handled?

What about authorization?

Are we sending data in the open?

Are we using cryptography properly?

Is there logging? What is stored?

Etc.

One of the best questions …

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Is there anything that keeps you up at night worrying about this system?

Your threat model now consists of …

1. Diagram / visual model of your system
2. Elements of your system and the interactions
3. Threats identified through answers to questions

Determine mitigations and risks

- Mitigation Options:
  - Leave as-is
  - Remove from product
  - Remedy with technology countermeasure
  - Warn user
- What is the risk associated with the vulnerability?

Risk Management

- Bug Bar (Critical / Important / Moderate / Low)
- FAIR (Factor Analysis of Information Risk) – Jack Jones
- Risk Rating (High, Medium, Low)

Risk Rating

Overall risk of the threat expressed in High, Medium, or Low.

Risk is product of two factors:

- Ease of exploitation
- Business impact

Risk Rating – Ease of Exploitation

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Risk Rating	Description
High	• Tools and exploits are readily available on the Internet or other locations • Exploitation requires no specialized knowledge of the system and little or no programming skills • Anonymous users can exploit the issue
Medium	• Tools and exploits are available but need to be modified to work successfully • Exploitation requires basic knowledge of the system and may require some programming skills • User-level access may be a pre-condition
Low	• Working tools or exploits are not readily available • Exploitation requires in-depth knowledge of the system and/or may require strong programming skills • User-level (or perhaps higher privilege) access may be one of a number of pre-conditions

Risk Rating – Business Impact

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Risk Rating	Description
High	- Administrator-level access (for arbitrary code execution through privilege escalation for instance) or disclosure of sensitive information - Depending on the criticality of the system, some denial-of-service issues are considered high impact - All or significant number of users affected - Impact to brand or reputation
Medium	- User-level access with no disclosure of sensitive information - Depending on the criticality of the system, some denial-of-service issues are considered medium impact
Low	- Disclosure of non-sensitive information, such as configuration details that may assist an attacker - Failure to adhere to recommended best practices (which does not result in an immediately visible exploit) also falls into this bracket Low number of users affected

Example – Medium Risk Threat

ID - Risk	RT-3
Threat	Lack of CSRF protection allows attackers to submit commands on behalf of users
Description/Impact	Client applications could be subject to a CSRF attack where the attacker embeds commands in the client applications and uses it to submit commands to the server on behalf of the users
Countermeasures	Per transaction codes (nonce), thresholds, event visibility
Components Affected	CO-3

Your threat model now consists of …

1. Diagram / visual model of your system
2. Elements of your system and the interactions
3. Threats identified through answers to questions
4. Mitigations and risks identified to deal with the threats

Follow through

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Document what you found and decisions you make

File bugs or new requirements

Verify bugs fixed and new requirements implemented

Did we miss anything? Review again

Anything new? Review again

Your threat model now consists of …

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5. Follow through

A living threat model!

Your challenge

Add threat modeling to your toolkit

Consider threat modeling first (secure design, before new features, etc.)

Many ways … just do it!

Resources - Books

Threat Modeling: Designing for Security

Adam Shostack

Securing Systems: Applied Architecture and Threat Models

Brook S.E. Schoenfield

Risk Centric Threat Modeling: Process for Attack Simulation and Threat Analysis

Marco Morana and Tony UcedaVelez

Measuring and Managing Information Risk: A FAIR Approach

Jack Jones and Jack Freund

Resources - Tools

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Whiteboard

Visio (or equivalent) for diagraming

Word (or equivalent) or Excel (or equivalent) for documenting

Resources - Tools

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Attack Trees – Bruce Schneier on Security

- https://www.schneier.com/attacktrees.pdf

Microsoft Threat Modeling Tool 2016

- http://www.microsoft.com/en-us/download/details.aspx?id=49168

Threat Modeler Tool 3.0

- http://myappsecurity.com

Resources - Tools

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Elevation of Privilege (EoP) Game

http://www.microsoft.com/en-us/download/details.aspx?id=20303

OWASP Cornucopia

https://www.owasp.org/index.php/OWASP_Cornucopia

OWASP Application Security Verification Standard (ASVS)

https://www.owasp.org/index.php/Category:OWASP_Application_Security_Verification_Standard_Project

OWASP Proactive Controls (especially current 2016 work)

https://www.owasp.org/index.php/OWASP_Proactive_Controls

Questions?

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- **Contacts**
  - Web Site: https://roberthurlbut.com/
  - LinkedIn: https://www.linkedin.com/in/roberthurlbut/
  - Twitter: @RobertHurlbut