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Robert Hurlbut

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  • (ISC)2 CSSLP 2014-2017
  • Group Leader – Boston .NET Arch Group, Amherst Sec Group
  • Speaker at user groups and conferences

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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?

Threat modeling is the process of understanding your system and potential threats against your system. A threat model allows you to 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! 😊
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

Vulnerability

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

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

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 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)
Model the System

![Diagram showing the system model with users, server, and admin components, including request and response flows, and trust boundary.](image-url)
Model the system

1. User
2. Authn Engine
3. Credentials
4. Service
5. Mnmgt Tool
6. Data Files
7. Audit Engine
8. Audit Engine
9. Admin
Your threat model now consists of …

1. Diagram / visual model of your system
Identity the elements

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

Diagram:
- User sends a Request to Service.
- Service requests credentials.
- Authn Engine authenticates.
- Audit Engine audits.
- Mnmgt Tool manages.
- Data Flows between entities.
Your threat model now consists of …

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

Attack Trees
Threat Libraries (CAPEC, OWASP Top 10, SANS Top 25)
Checklists (ex: OWASP Application Security Verification Standard (ASVS))
Use Cases / Misuse Cases
Games: Elevation of Privilege (EoP), OWASP Cornucopia STRIDE
P.A.S.T.A. – Process for Attack Simulation and Threat Analysis (combining STRIDE + Attacks + Risk Analyses)
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

<table>
<thead>
<tr>
<th>Threat</th>
<th>Property we want</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spoofing</td>
<td>Authentication</td>
</tr>
<tr>
<td>Tampering</td>
<td>Integrity</td>
</tr>
<tr>
<td>Repudiation</td>
<td>Non-repudiation</td>
</tr>
<tr>
<td>Information Disclosure</td>
<td>Confidentiality</td>
</tr>
<tr>
<td>Denial of Service</td>
<td>Availability</td>
</tr>
<tr>
<td>Elevation of Privilege</td>
<td>Authorization</td>
</tr>
</tbody>
</table>

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

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Identify Threats

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 …

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?
Determine mitigations and risks

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

<table>
<thead>
<tr>
<th>Risk Rating</th>
<th>Description</th>
</tr>
</thead>
</table>
| 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

<table>
<thead>
<tr>
<th>Risk Rating</th>
<th>Description</th>
</tr>
</thead>
</table>
| **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 user affected |
## Example – Medium Risk Threat

<table>
<thead>
<tr>
<th>ID - Risk</th>
<th>RT-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threat</td>
<td>Lack of CSRF protection allows attackers to submit commands on behalf of users</td>
</tr>
<tr>
<td>Description/Impact</td>
<td>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</td>
</tr>
<tr>
<td>Countermeasures</td>
<td>Per transaction codes (nonce), thresholds, event visibility</td>
</tr>
<tr>
<td>Components Affected</td>
<td>CO-3</td>
</tr>
</tbody>
</table>
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

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 …

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
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** book by Adam Shostack

**Securing Systems: Applied Architecture and Threat Models** by Brook S.E. Schoenfield

**Risk Centric Threat Modeling: Process for Attack Simulation and Threat Analysis** book by Marco Morana and Tony UcedaVelez

**Measuring and Managing Information Risk: A FAIR Approach** by Jack Jones and Jack Freund
Resources - Tools

Whiteboard
Visio (or equivalent) for diagraming
Word (or equivalent) or Excel (or equivalent) for documenting
Resources - Tools

Microsoft Threat Modeling Tool 2016

Threat Modeler Tool 3.0
http://myappsecurity.com

Elevation of Privilege (EoP) Game

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

OWASP Application Security Verification Standard (ASVS)
Questions?

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