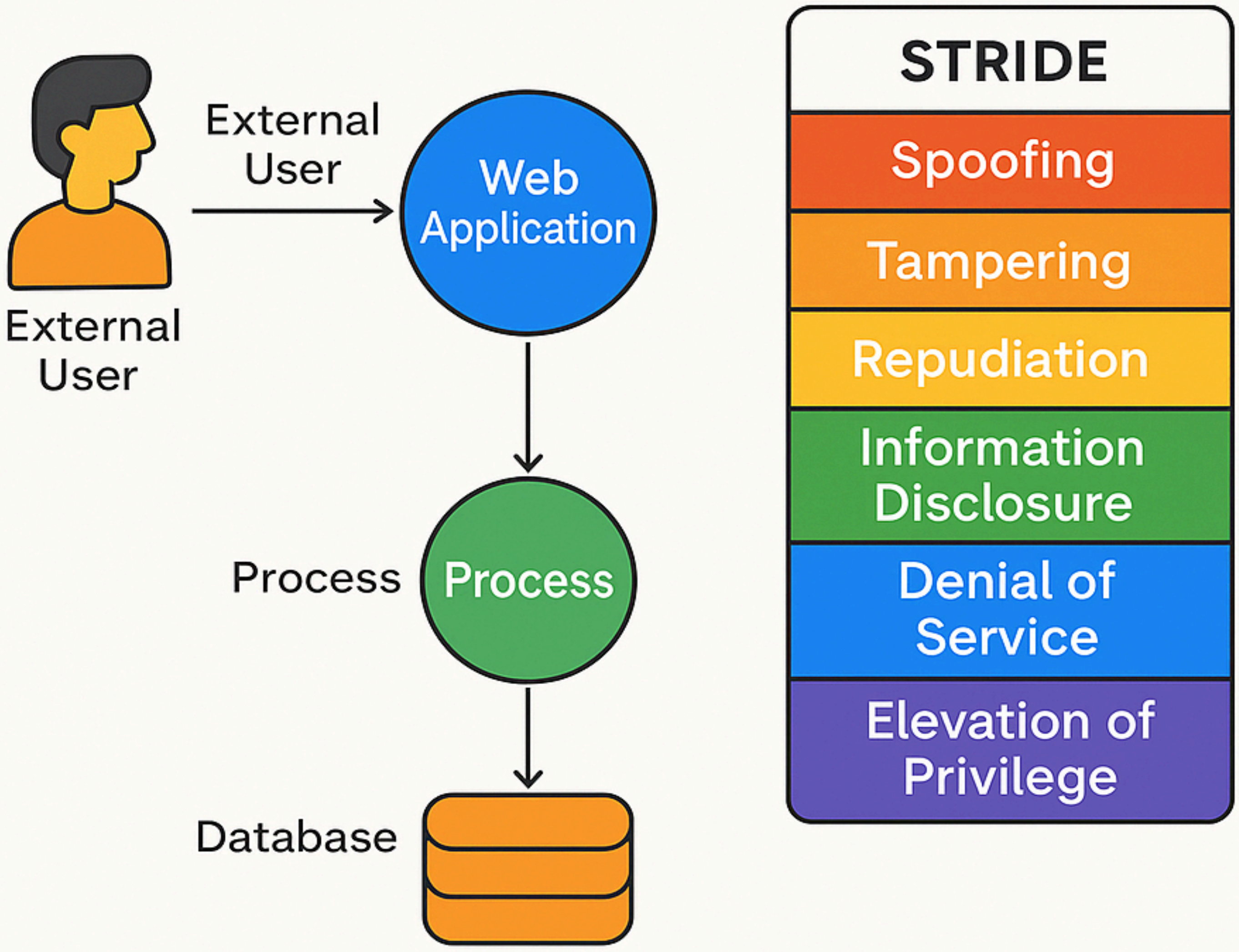
Advanced Threat Modeling

Methodologies and Implementation Strategies for Security Architects



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Advanced Threat Modeling: Methodologies and Implementation Strategies for Security Architects

Introduction

Threat modeling represents one of the most powerful yet underutilized practices in cybersecurity. As systems become increasingly complex and interconnected, the ability to systematically identify, categorize, and mitigate potential security threats before they materialize becomes essential. Threat modeling provides a structured approach to envisioning and addressing security concerns during system design rather than after deployment, substantially reducing both risk and remediation costs. This comprehensive guide explores advanced threat modeling methodologies, practical implementation strategies, and integration approaches for security architects and development teams seeking to build security into the fabric of their systems.

Threat Modeling Fundamentals

The Core Principles of Effective Threat Modeling

Regardless of methodology, effective threat modeling adheres to several fundamental principles:

1. Systematic Approach: Following a structured process rather than ad-hoc security reviews
2. Attacker Perspective: Examining systems from an adversarial viewpoint
3. Risk-Based Prioritization: Focusing efforts on the most significant threats
4. Early Integration: Applying threat modeling during design rather than after implementation
5. Continuous Refinement: Updating models as systems and threats evolve

The Threat Modeling Process Framework

The core threat modeling process consists of four primary phases:

```
┌─────────────────┐     ┌─────────────────┐     ┌─────────────────┐
│ System          │────►│ Threat          │────►│ Mitigation      │
│ Decomposition   │     │ Identification  │     │ Development     │
└─────────────────┘     └─────────────────┘     └─────────────────┘
        ▲                                                │
        │                                                │
        └────────────────────────────────────────────────┘
                          Validation
```

1. System Decomposition: Creating a comprehensive model of the system architecture, data flows, trust boundaries, and assets
2. Threat Identification: Systematically identifying potential threats using structured methodologies

3. Mitigation Development: Designing controls and countermeasures to address identified threats
4. Validation: Verifying that mitigations effectively address the identified threats

Advanced Threat Modeling Methodologies

STRIDE Methodology Deep Dive

Microsoft's STRIDE framework remains one of the most widely adopted threat modeling approaches, providing a mnemonic for six threat categories:

Threat Type	Definition	Example Attack Vectors	Typical Security Properties
Spoofing	Impersonating something or someone else	Session hijacking, phishing, IP spoofing	Authentication
Tampering	Modifying data or code	Parameter tampering, SQL injection, binary manipulation	Integrity
Repudiation	Claiming to not have performed an action	Disabling audit logs, log forgery, timestamp manipulation	Non-repudiation
Information Disclosure	Exposing information to unauthorized individuals	Path traversal, CSRF, unintended data leakage	Confidentiality
Denial of Service	Degrading or blocking access to services	Resource exhaustion, flooding attacks, deadlocks	Availability
Elevation of Privilege	Gaining higher privileges than intended	Vertical/horizontal privilege escalation, buffer overflows	Authorization

Implementing STRIDE Analysis Systematically

Here's a simple approach to implementing STRIDE analysis in code:

```python
def analyze_component_threats(component, dataflows):
    threats = []

    # Analyze Spoofing threats
    if component.has_authentication:
        threats.append({
            "type": "Spoofing",
            "description": f"Attacker impersonates {component.name}",
            "affected_property": "Authentication",
            "risk_level": "High" if component.is_internet_facing else "Medium"
        })

    # Analyze Tampering threats
    if component.processes_data or component.stores_data:
        threats.append({
            "type": "Tampering",
            "description": f"Attacker modifies data in {component.name}",
            "affected_property": "Integrity",
            "risk_level": "High" if component.data_sensitivity == "critical"
else "Medium"
        })

    # Continue with other STRIDE categories...

    return threats
```

PASTA Methodology Implementation

The Process for Attack Simulation and Threat Analysis (PASTA) offers a risk-centric methodology:

```
┌────────────────┐      ┌────────────────┐      ┌────────────────┐
┌────────────────┐
│ I. Define      │────▶│ II. Define     │────▶│ III. Analyze   │────▶│ IV.
Enumerate │
│ Objectives     │      │ Technical      │      │ Application    │      │
Vulnerabilities
└────────────────┘      │ Scope          │      │ Decomposition  │
└────────────────┘
                        └────────────────┘      └────────────────┘
                                                                            ▼
┌────────────────┐      ┌────────────────┐      ┌────────────────┐
│ VII. Analyze   │◀────│ VI. Identify   │◀────│ V. Analyze     │
│ & Develop      │      │ Countermeasures       │ Threats        │
│ Controls       │      └────────────────┘      └────────────────┘
└────────────────┘
```

PASTA takes a more comprehensive approach by incorporating business objectives and attacker motivation into the analysis, making it well-suited for complex enterprise applications.

DREAD Risk Assessment Model

DREAD provides a quantitative risk assessment framework by evaluating:

1. Damage Potential: How severe is the damage if the vulnerability is exploited?
2. Reproducibility: How easy is it to reproduce the attack?
3. Exploitability: How much effort and expertise is needed to exploit the vulnerability?
4. Affected Users: How many users would be affected by the exploit?
5. Discoverability: How easy is it to discover the vulnerability?

Each factor is typically rated on a scale of 1-10, and the final risk score is calculated as:

```
Risk Score = (D + R + E + A + D) / 5
```

A simple implementation might look like:

```
function calculateDreadScore(threat) {
  const damage = evaluateDamagePotential(threat);
  const reproducibility = evaluateReproducibility(threat);
  const exploitability = evaluateExploitability(threat);
  const affectedUsers = evaluateAffectedUsers(threat);
  const discoverability = evaluateDiscoverability(threat);

  const score = (damage + reproducibility + exploitability +
                affectedUsers + discoverability) / 5;

  return {
    score: score,
    risk_level: score < 3 ? "Low" : (score < 7 ? "Medium" : "High"),
    factors: {
      damage, reproducibility, exploitability, affectedUsers, discoverability
    }
  };
}
```

Attack Trees for Complex Threat Modeling

Attack trees provide a structured approach to modeling complex attack scenarios:

```
Root Goal: Obtain Administrative Access to Financial Database
|
├── Attack Vector 1: SQL Injection
│   ├── Discover vulnerable parameter (AND)
│   ├── Craft malicious payload (AND)
│   ├── Execute injection attack (AND)
│   ├── Escalate to system commands (AND)
│   └── Create backdoor account
│
├── Attack Vector 2: Credential Theft
│   ├── Target Database Administrator
│   │   ├── Phishing attack (OR)
│   │   ├── Malware deployment (OR)
│   │   └── Social engineering
│   └── Use stolen credentials
│
└── Attack Vector 3: Exploit Unpatched Vulnerability
    ├── Identify database version (AND)
    ├── Research known vulnerabilities (AND)
    ├── Develop/acquire exploit (AND)
    └── Execute exploit
```

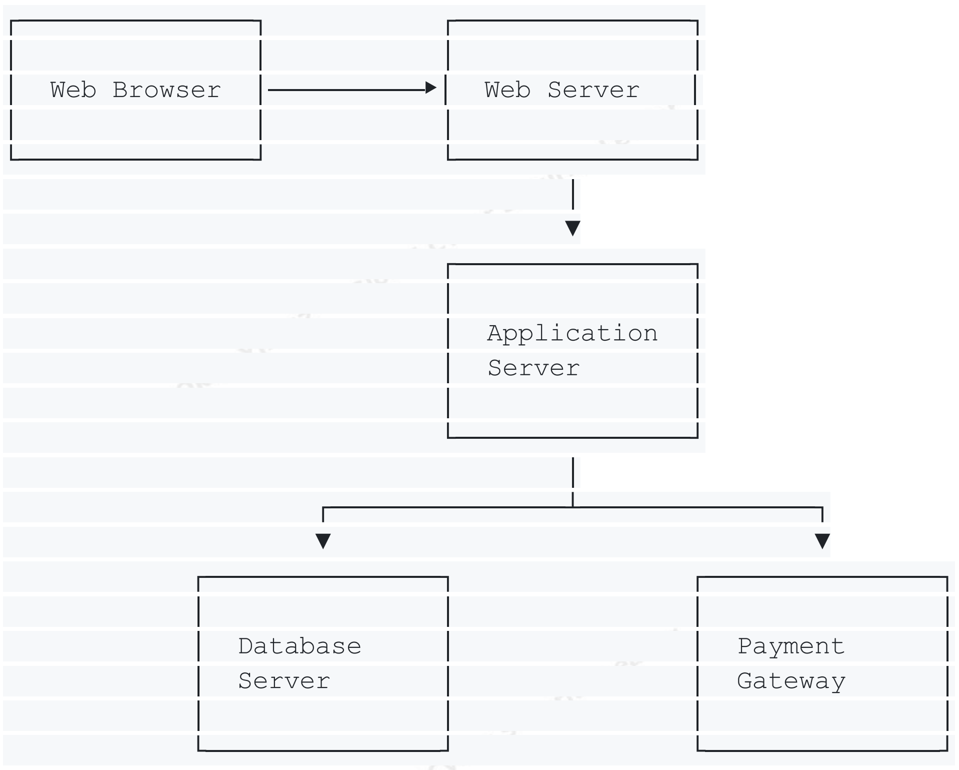
Attack trees can be implemented programmatically:

```
class AttackNode {
  constructor(name, type = "AND", probability = 0, cost = 0) {
    this.name = name;
    this.type = type; // AND or OR
    this.children = [];
    this.probability = probability; // 0 to 1
    this.cost = cost; // Estimated attack cost
  }

  addChild(child) {
    this.children.push(child);
  }

  // Calculate success probability based on node type
  calculateProbability() {
    if (!this.children.length) return this.probability;

    if (this.type === "AND") {
      // All children must succeed
      return this.children.reduce((p, child) => p *
child.calculateProbability(), 1);
    } else { // OR
      // Any child can succeed
      return 1 - this.children.reduce((p, child) =>
        p * (1 - child.calculateProbability()), 1);
    }
  }
}
```

System Decomposition Techniques

Data Flow Diagrams (DFDs) for Threat Modeling

Data Flow Diagrams provide a visual representation of how information moves through a system:



For threat modeling, standard DFDs are enhanced with:

1. Trust Boundaries: Lines or containers indicating where trust levels change
2. Data Classifications: Indicators of the sensitivity level of data in each flow
3. Authentication Points: Markers for where authentication occurs

Trust Boundary Identification and Analysis

Trust boundaries represent the points where data or control flow crosses between different trust levels. Key trust boundaries include:

1. Process Boundaries: Between different software processes
2. Network Boundaries: Between network segments (e.g., internet to DMZ)
3. Physical Boundaries: Between physical locations

4. Trust Level Boundaries: Between security contexts (e.g., authenticated vs. unauthenticated)

A simple function to identify flows crossing trust boundaries might look like:

```
def identify_boundary_crossings(dataflows, trust_boundaries):
    boundary_crossings = []

    for flow in dataflows:
        source_boundaries = get_boundaries_for_component(flow.source,
trust_boundaries)
        dest_boundaries = get_boundaries_for_component(flow.destination,
trust_boundaries)

        # Check if flow crosses any boundaries
        if not all(sb in dest_boundaries for sb in source_boundaries):
            boundary_crossings.append({
                "flow": flow,
                "source_boundaries": source_boundaries,
                "dest_boundaries": dest_boundaries,
                "risk_level": "High" if flow.data_classification == "sensitive"
else "Medium"
            })

    return boundary_crossings
```

Threat Identification and Analysis Techniques

STRIDE-per-Element Analysis

STRIDE can be systematically applied to each system element:

- For each process in the system, analyze potential:
  - Spoofing (e.g., service impersonation)
  - Tampering (e.g., memory manipulation)
  - Repudiation (e.g., action denial)
  - Information disclosure (e.g., memory dumps)
  - Denial of service (e.g., resource exhaustion)
  - Elevation of privilege (e.g., buffer overflows)
- For each data store, analyze potential:
  - Tampering (e.g., unauthorized modifications)
  - Information disclosure (e.g., insecure storage)
  - Denial of service (e.g., resource exhaustion)
- For each data flow, analyze potential:
  - Tampering (e.g., man-in-the-middle attacks)

    - Information disclosure (e.g., eavesdropping)
    - Denial of service (e.g., flow disruption)
- For each external entity, analyze potential:
    - Spoofing (e.g., entity impersonation)
    - Repudiation (e.g., action denial)

Threat Scenario Development

Developing detailed threat scenarios provides context for identified threats. A comprehensive threat scenario includes:

```yaml
# Example threat scenario structure
threat_scenario:
  id: "TS-AUTH-007"
  name: "Authentication Bypass via JWT Token Manipulation"
  description: "Attacker modifies JWT token to elevate privileges"

  threat_actor:
    type: "External"
    motivation: "Unauthorized access to sensitive data"
    capabilities: "Medium technical skills"

  prerequisites:
    - "Knowledge of the JWT format"
    - "Ability to intercept a valid JWT token"

  attack_flow:
    - "Attacker obtains a legitimate JWT token"
    - "Attacker decodes the token to analyze structure"
    - "Attacker modifies claims (e.g., role, permissions)"
    - "Attacker uses modified token to access the application"

  technical_impact:
    - "Unauthorized access to restricted functionality"
    - "Potential privilege escalation"

  business_impact:
    - "Regulatory compliance violations"
    - "Unauthorized access to sensitive customer data"

  likelihood: "Medium"
  severity: "High"
  risk_rating: "High"

  mitigations:
    - mitigation: "Implement proper signature validation"
      effectiveness: "High"
```

Threat Intelligence Integration

Incorporating threat intelligence enhances threat modeling with real-world attacker behaviors:

1. MITRE ATT&CK Framework: Map system components to relevant ATT&CK techniques
2. Industry-Specific Intelligence: Incorporate threats targeting your specific industry
3. Vulnerability Databases: Analyze CVEs relevant to your technology stack
4. Threat Actor Profiles: Consider known threat actors targeting similar systems

Mitigation and Control Development

Threat Mitigation Mapping

Systematically mapping threats to controls ensures comprehensive coverage. Here's an example structure for mapping authentication threats to controls:

```
const threatMitigationMap = {
  authentication_threats: {
    password_brute_force: {
      controls: [
        {
          name: "Account lockout policy",
          effectiveness: "high",
          implementation: "Lock accounts after multiple failed attempts"
        },
        {
          name: "Multi-factor authentication",
          effectiveness: "high",
          implementation: "Require second factor for authentication"
        }
      ]
    },
    session_hijacking: {
      controls: [
        {
          name: "Secure cookie attributes",
          effectiveness: "medium",
          implementation: "Set HttpOnly, Secure, and SameSite flags"
        },
        {
          name: "Session timeout",
          effectiveness: "medium",
          implementation: "Expire sessions after period of inactivity"
        }
      ]
    }
  }
};
```

Security Control Implementation Example

Here's a simple example of implementing a security control for JWT token validation:

```
// JWT token validation middleware (Node.js/Express example)
function validateJwtToken(req, res, next) {
  const token = req.headers.authorization?.split(' ')[1];

  if (!token) {
    return res.status(401).json({ error: 'Missing authorization token' });
  }

  try {
    // Verify the token (uses RS256 algorithm with public key)
    const decoded = jwt.verify(token, PUBLIC_KEY, {
      algorithms: ['RS256'],        // Only allow specific algorithm
      issuer: 'https://auth.company.com',  // Validate issuer
      audience: 'https://api.company.com'  // Validate audience
    });

    // Check if token has been revoked
    if (isTokenRevoked(decoded.jti)) {
      return res.status(401).json({ error: 'Token has been revoked' });
    }

    // Add user context to request
    req.user = decoded;
    next();
  } catch (err) {
    return res.status(401).json({ error: 'Invalid token' });
  }
}
```

Integration with Development Lifecycle

DevSecOps Integration of Threat Modeling

Automating threat modeling within CI/CD pipelines:

1. Design Phase: Initial threat modeling during architectural design
2. Implementation Phase: Continuous threat modeling as new components are developed
3. Testing Phase: Validate that mitigations address identified threats
4. Deployment Phase: Final security verification before production
5. Operations Phase: Continuous monitoring for new threats

Threat Model as Code

Representing threat models in code enables version control and automation:

```yaml
# threat-model.yaml - Threat Model as Code example
system:
  name: "E-commerce Platform"
  version: "2.0"
  description: "Cloud-based e-commerce platform"

components:
  - id: "web-app"
    name: "Web Application"
    type: "web-application"
    technology: "React.js"
    trust_level: "untrusted"

  - id: "api-gateway"
    name: "API Gateway"
    type: "gateway"
    technology: "Kong"
    trust_level: "semi-trusted"

  - id: "auth-service"
    name: "Authentication Service"
    type: "service"
    technology: "Node.js"
    trust_level: "trusted"

data_flows:
  - id: "flow-1"
    name: "Authentication Flow"
    source: "web-app"
    destination: "api-gateway"
    data: "User credentials"
    data_classification: "confidential"

trust_boundaries:
  - id: "boundary-1"
    name: "Internet Boundary"
    description: "Separates untrusted internet from internal systems"
    components: ["web-app"]
```

```yaml
threats:
  - id: "threat-1"
    name: "Authentication Bypass"
    category: "spoofing"
    affected_components: ["auth-service"]
    status: "mitigated"
```

Threat Model Validation Through Security Testing

Validating threat models through security testing ensures they accurately reflect reality:

```python
# Example of a threat model validation test
def test_authentication_bypass_mitigations(api_url):
    # Test case based on threat-1 from threat model
    print("Testing authentication bypass mitigations...")

    # Test 1: Attempt to access protected endpoint without authentication
    response = requests.get(f"{api_url}/api/protected")
    assert response.status_code == 401, "Should reject unauthenticated requests"

    # Test 2: Attempt to use an expired token
    expired_token = generate_expired_token()
    response = requests.get(
        f"{api_url}/api/protected",
        headers={"Authorization": f"Bearer {expired_token}"}
    )
    assert response.status_code == 401, "Should reject expired tokens"

    # Test 3: Attempt to use a tampered token
    tampered_token = generate_tampered_token()
    response = requests.get(
        f"{api_url}/api/protected",
        headers={"Authorization": f"Bearer {tampered_token}"}
    )
    assert response.status_code == 401, "Should reject tampered tokens"

    print("All authentication bypass mitigations are effective")
```

Tool Support for Threat Modeling

Comparison of Threat Modeling Tools

Feature	Microsoft TMT	OWASP Threat Dragon	IriusRisk	ThreatModeler
Diagramming Support	Built-in	Built-in	Built-in	Built-in
Methodology Support	STRIDE	STRIDE	Multiple	Multiple
Automatic Threat Generation	Basic	Limited	Advanced	Advanced
Integration with Development Tools	Limited	GitHub only	Extensive	Extensive
Collaboration Features	Limited	Yes	Advanced	Advanced
Risk Assessment	Basic	Basic	Advanced	Advanced
Compliance Mapping	Limited	No	Yes	Yes
API Support	No	Limited	Yes	Yes

```
├──────────────────────────┼────────────────────┼────────────────────┼────────────────────┼────
────────────────┤
│ Cost                     │ Free               │ Free               │ Commercial         │
Commercial       │
│                          │                    │                    │                    │
│
└──────────────────────────┴────────────────────┴────────────────────┴────────────────────┴────
────────────────┘
```

Tool selection should be based on your organization's specific needs, existing tool integration, and budget constraints.

Practical Implementation and Migration Strategies

Phased Implementation Approach

Threat modeling implementation typically follows this progression:

```
┌─────────────────┐      ┌──────────────────┐      ┌──────────────────┐
│ Phase 1:        │────▶│ Phase 2:         │────▶│ Phase 3:         │
│ High-Value      │      │ Expand to        │      │ Enterprise       │
│ Applications    │      │ Related Apps     │      │ Coverage         │
└─────────────────┘      └──────────────────┘      └──────────────────┘
```

1. Phase 1: Begin with high-value or high-risk applications
2. Phase 2: Expand to functionally related applications
3. Phase 3: Implement across the entire enterprise

Integration with Existing Security Processes

Threat modeling should integrate with existing security processes:

1. Security Requirements: Feed threat model outputs into security requirements
2. Architecture Review: Incorporate threat modeling into architecture reviews
3. Code Review: Focus code reviews on mitigating identified threats
4. Security Testing: Validate threat model assumptions through testing
5. Incident Response: Update threat models based on real incidents

Case Studies and Real-World Implementations

Financial Services Threat Modeling

A global financial institution implemented threat modeling for their digital banking platform:

1. Approach: Combined STRIDE with attack trees

2. Focus Areas: Authentication, transaction processing, data storage
3. Key Findings: Identified previously unknown authentication bypass and potential API-level data leakage
4. Results: 35% reduction in vulnerabilities found in production, 62% cost reduction for security fixes

Healthcare Application Security

A healthcare software provider integrated threat modeling into their SDLC:

1. Approach: PASTA methodology with healthcare-specific threat intelligence
2. Focus Areas: Patient data privacy, regulatory compliance, system availability
3. Key Findings: Discovered potential PHI exposure in logging systems and insufficient access controls
4. Results: Achieved regulatory compliance while reducing security incidents by 40%

Best Practices and Lessons Learned

Critical Success Factors

Several factors contribute to successful threat modeling implementations:

1. Executive Sponsorship: Senior leadership buy-in ensures organizational alignment and sufficient resources
2. Clear Success Metrics: Establish measurable objectives to track progress and demonstrate value
3. Phased Approach: Implement incrementally, focusing on high-value assets first
4. Right Level of Detail: Balance comprehensive analysis with practical completion timeframes
5. Developer Engagement: Involve developers early to ensure implementation practicality

Common Implementation Pitfalls

Avoid these common mistakes in threat modeling implementations:

1. Excessive Complexity: Overly detailed models become unmanageable
2. Tool Fixation: Focusing on tools rather than the underlying methodology
3. Single-Person Dependency: Relying on one security expert rather than building team capacity
4. Late Integration: Introducing threat modeling after design decisions are finalized

5. Limited Scope: Focusing only on technical threats while ignoring business impacts

Future Trends in Threat Modeling

Emerging developments in threat modeling include:

1. AI-Enhanced Threat Identification: Machine learning to identify potential threats based on system architecture
2. Automated Mitigation Recommendations: AI-driven security control recommendations
3. Supply Chain Threat Modeling: Extending models to include dependencies and third-party components
4. Real-Time Threat Model Updates: Continuous updating of threat models based on operational intelligence
5. Cloud-Native Threat Modeling: Specialized approaches for cloud and containerized architectures

Conclusion

Threat modeling represents a foundational security practice that bridges the gap between theoretical security knowledge and practical application. By systematically analyzing potential threats before implementation, organizations can build security into their systems from the ground up, substantially reducing both security incidents and remediation costs.

The most effective threat modeling approaches combine structured methodologies with domain-specific knowledge, creating a comprehensive view of potential vulnerabilities. By integrating threat modeling into the development lifecycle and continuously refining models based on new threats and findings, organizations can maintain robust security postures even as their systems evolve.

While implementing threat modeling requires initial investment in tools, training, and process integration, the return on investment through reduced vulnerabilities, faster remediation, and enhanced security awareness makes it an essential practice for modern security programs.

Frequently Asked Questions

How does threat modeling differ from other security assessment methodologies?

Threat modeling differs from other security assessments in several key ways:

1. Proactive vs. Reactive: Threat modeling identifies potential vulnerabilities before implementation, while most assessment methods (like penetration testing) evaluate existing systems.
2. Architectural Focus: Threat modeling examines system design and architecture rather than implementation details or running code.
3. Comprehensive Scope: Rather than identifying individual vulnerabilities, threat modeling systematically analyzes entire attack surfaces and threat landscapes.
4. Developer Engagement: Unlike many security assessments performed solely by security specialists, effective threat modeling involves developers and architects.
5. Earlier Integration: Threat modeling occurs during the design phase, whereas most security assessments happen after implementation.

These differences make threat modeling complementary to other security practices rather than a replacement for them.

What is the optimal timing for threat modeling in the development lifecycle?

The optimal timing for threat modeling follows a "shift-left" approach:

1. Initial Architecture Design: The first threat modeling session should occur as soon as the high-level architecture is defined, focusing on major components and data flows.
2. Feature Design: Additional threat modeling occurs during feature design, particularly for security-critical features like authentication, authorization, and data handling.
3. Pre-Implementation Review: A final review before coding begins ensures all identified threats have corresponding security requirements.
4. Design Change Reviews: Whenever significant design changes occur, additional threat modeling sessions should reassess the security implications.
5. Continuous Updates: The threat model should be a living document, updated as the system evolves and new threats emerge.

This approach balances thoroughness with practicality by integrating threat modeling throughout the lifecycle without creating bottlenecks.

How can organizations measure the effectiveness of their threat modeling program?

Effective threat modeling measurement requires both process and outcome metrics:

1. Process Metrics:
   - Percentage of projects with completed threat models
   - Average time to complete a threat model
   - Number of threats identified per application
   - Percentage of threats with defined mitigations
2. Outcome Metrics:
   - Reduction in vulnerabilities found in later testing phases
   - Reduction in security issues discovered in production
   - Decrease in security incident remediation costs
   - Increased developer security awareness and engagement
3. ROI Metrics:
   - Cost savings from early vulnerability identification
   - Reduced security-related project delays
   - Decreased cost of compliance verification
   - Prevention of security incidents

Organizations should establish a baseline before implementing threat modeling and track improvements over time to demonstrate value.

How do you scale threat modeling across large organizations?

Scaling threat modeling across enterprise organizations requires:

1. Tiered Approach: Implement different levels of threat modeling depth based on application risk:
   - High-risk applications: Comprehensive threat modeling with security specialists
   - Medium-risk applications: Focused threat modeling for key components
   - Low-risk applications: Self-service threat modeling using templates
2. Centers of Excellence: Create a threat modeling center of excellence to:
   - Develop organization-specific methodologies and templates
   - Train development teams on threat modeling techniques
   - Provide expert consultation for complex applications
   - Review and validate threat models for critical systems
3. Tool Standardization: Implement consistent tools across the organization to:
   - Enable knowledge sharing between teams
   - Facilitate threat model review and comparison
   - Support integration with development toolchains
   - Enable reporting and metrics aggregation
4. Automation: Leverage automation to:

  - Generate baseline threat models from architecture diagrams
  - Identify common threats based on technology stack
  - Track threat mitigation implementation status
  - Update threat models based on code changes

This scaled approach balances thoroughness with efficiency by applying resources where they deliver the greatest security benefit.

How should threat modeling adapt for DevOps and agile environments?

Threat modeling in fast-paced development environments requires adaptation:

1. Iterative Approach: Break threat modeling into smaller, iterative sessions aligned with development sprints rather than comprehensive up-front analysis.
2. Threat Modeling as Code: Represent threat models in machine-readable formats to enable version control, automated analysis, and integration with CI/CD pipelines.
3. Reusable Components: Create a library of pre-analyzed components with associated threats and mitigations to accelerate modeling of new systems.
4. Just-in-Time Analysis: Perform focused threat modeling on features immediately before development rather than waiting for complete system designs.

5. Security Champions: Embed security-trained developers in each team to facilitate lightweight threat modeling without dependencies on central security teams.

This adapted approach maintains security rigor while aligning with the speed requirements of modern development methodologies.