Authentication & Security in Large Scale Systems: JWT, OAuth, Sessions, and API Protection

Subtitle: Learn how production systems secure users, protect APIs, manage authentication flows, and prevent large scale security failures.

Website Name: haas.dev
Website Link: https://dev-roast-app.vercel.app

Introduction

Most beginner developers think security means:

• adding a login form
• storing passwords in a database
• adding simple tokens

In real production systems, security is one of the most critical engineering layers.

Because systems today handle:

• personal data
• financial transactions
• private communications
• enterprise workloads

A single security mistake can cause:

• data leaks
• account takeover
• financial loss
• system compromise

This is why large scale systems treat security as:

an architectural concern, not a feature

This PDF explains how authentication and security actually work in production systems.

Chapter 1: Authentication vs Authorization

Authentication

Means:

verifying who the user is

Example:
• login system

Authorization

Means:

what the user is allowed to do

Example:
• admin access vs normal user

Key Insight

Authentication answers:
• who are you

Authorization answers:
• what can you access

Chapter 2: Why Security Becomes Hard at Scale

At small scale:
• simple login system works

At large scale:
• millions of users
• distributed services
• multiple APIs
• third party integrations

Problems include:

• token theft
• session hijacking
• API abuse
• unauthorized access
• service-to-service trust issues

Chapter 3: Password Storage (Critical Foundation)

Passwords should NEVER be stored as plain text.

Correct Approach

Use:
• hashing algorithms

Common Methods

• bcrypt
• Argon2
• scrypt

Why hashing matters

Even if database leaks:
• passwords remain protected

Chapter 4: Sessions Based Authentication

Sessions store authentication state on server.

Flow

User logs in
→ server creates session
→ session stored in database or memory
→ session ID sent to client

Pros

• secure
• easy to invalidate

Cons

• hard to scale across multiple servers

Chapter 5: Token Based Authentication

Tokens are stateless authentication methods.

Example

JWT (JSON Web Token)

Flow

User logs in
→ server generates token
→ client stores token
→ token sent with every request

Pros

• scalable
• stateless
• works well in distributed systems

Cons

• harder to revoke
• token leakage risk

Chapter 6: JWT Internals

JWT contains:

• header
• payload
• signature

Important Insight

JWT is NOT encrypted by default.

It is:
• signed
not hidden

Meaning

Anyone can read payload
but cannot modify it without signature break

Chapter 7: OAuth Authentication

OAuth is used for:

third party login systems

Example

• “Login with Google”
• “Login with GitHub”

Flow

User → Provider → Authorization → Token issued

Benefits

• no password sharing
• secure delegation

Chapter 8: API Security Basics

APIs must always be protected.

Common Methods

• API keys
• tokens
• OAuth
• IP filtering

Key Insight

Public APIs without security:
• get abused immediately

Chapter 9: Rate Limiting

Rate limiting prevents abuse.

Example

Limit:
• 100 requests per minute

Prevents:

• DDoS attacks
• spam requests
• system overload

Chapter 10: Role Based Access Control (RBAC)

RBAC defines:

permissions based on user roles

Example Roles

• admin
• user
• moderator

Benefit

Simplifies large scale permission management

Chapter 11: Encryption

Encryption protects data in transit and storage.

Types

• at rest encryption
• in transit encryption

Example

HTTPS uses:
• TLS encryption

Benefit

Prevents data interception

Chapter 12: Secure Communication Between Services

Microservices must trust each other securely.

Solutions

• service tokens
• mutual TLS
• internal authentication

Problem

Internal APIs are also attack targets

Chapter 13: Session Hijacking Risks

Attackers can steal session tokens.

Prevention

• secure cookies
• HTTPS
• short session lifetime

Chapter 14: CSRF Attacks

CSRF means:

Cross Site Request Forgery

Problem

Attacker tricks user into unwanted action

Protection

• CSRF tokens
• same site cookies

Chapter 15: XSS Attacks

XSS means:

Cross Site Scripting

Problem

Injecting malicious scripts into website

Prevention

• input sanitization
• escaping outputs

Chapter 16: SQL Injection

One of the most dangerous vulnerabilities.

Problem

Attacker injects SQL queries

Prevention

• parameterized queries
• ORM usage

Chapter 17: Security in Microservices

Each service must:

• authenticate requests
• validate tokens
• verify permissions

Problem

One weak service compromises entire system

Chapter 18: Secrets Management

Applications use:

• API keys
• database credentials
• tokens

Never:

• hardcode secrets

Use:

• secret managers
• vault systems

Chapter 19: Secure API Design

Good APIs ensure:

• least privilege access
• input validation
• authentication checks

Principle

Never trust client input

Chapter 20: Logging Sensitive Data

Bad practice:

• logging passwords
• logging tokens

Correct practice:

• redact sensitive information

Chapter 21: Security Monitoring

Systems monitor:

• login attempts
• suspicious activity
• API abuse patterns

Benefit

Early detection of attacks

Chapter 22: Zero Trust Architecture

Modern systems assume:

no component is trusted by default

Every request must be verified

Chapter 23: Real Production Security Flow

User Request
→ API Gateway
→ Authentication Service
→ Authorization Check
→ Service Access
→ Logging + Monitoring

Chapter 24: Common Beginner Mistakes

• storing plain passwords
• ignoring API security
• exposing tokens
• trusting frontend validation

Chapter 25: Security vs Usability Tradeoff

Stronger security often adds:

• friction
• complexity
• latency

Chapter 26: Senior Engineering Thinking

Senior engineers think:

• “How can this be attacked?”
• “What happens if this leaks?”
• “How do we limit damage?”

Chapter 27: Final Security Principle

Security is not a feature, it is a system-wide constraint

Key Takeaways

• Authentication verifies identity, authorization controls access
• Passwords must always be hashed
• JWT enables scalable stateless authentication
• OAuth enables secure third party login
• APIs must always be protected with multiple layers
• Rate limiting prevents abuse and overload
• Encryption protects data in transit and storage
• Security must be designed into architecture, not added later

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