

# API Rate Limiter

## Team Codevengers

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# Introduction

A Node.js middleware to enforce rate limits on API endpoints to prevent abuse.

## Core Features:

- Multi-Window Rate Limiting: Concurrent enforcement across second, minute, hour, and day windows
- Tiered Client System
- Allowlist/blocklist with CIDR notation for both IPv4 and IPv6
- Real-Time Configuration: Hot-reload capabilities for policies & limits
- Custom error messages, HTTP 429 responses with retry-after headers

### Client Identification System (3 user stories)

- API key based identification
- IP based identification
- Allowlists/blocklists

### Configuration Management (5 user stories)

- Admin can manually block sources
- Update rules without service restarts
- Config validation before applying changes
- Rule precedence / hierarchy
- Configurable error messages for blocked responses

### Monitoring & Analytics (2 user stories)

- Proactive alerts when clients approach limits
- Expose rate limit info in response headers

### Rate Limiting Engine (3 user stories)

- Multiple time windows
- Different limits per endpoint / IP / API key
- Forward approved requests to target API servers

# JIRA & SPRINT MANAGEMENT

## Sprint 1

Screenshot of a Jira Backlog board for "ARL board" during "ARL Sprint 1".

The backlog contains the following items:

Work Item	Description	Assignee	Status	Priority	Due Date	Comments
ARL-3	API Key based Client Identification	CLIENT IDENTIFICA...	DONE	5	~	RB
ARL-4	IP based Client Identification with CIDR	CLIENT IDENTIFICA...	DONE	5	~	RS
ARL-8	Allow different limits per endpoint, IP, or API key	RATE LIMITING ENG...	DONE	3	~	JR
ARL-6	Enforce rate limits per client across multiple time windows	RATE LIMITING ENG...	DONE	8	~	RB
ARL-9	Forward approved requests to the target API servers	RATE LIMITING ENG...	DONE	5	~	RS
ARL-5	IP allowlists and blocklists	CLIENT IDENTIFICA...	DONE	5	~	RG
ARL-20	Allow configurable custom error messages for blocked/rate-limited responses	CONFIGURATION M...	TO DO	5	~	RG
ARL-37	Integration Testing	CLIENT IDENTIFICA...	TO DO	-	=	RG
ARL-36	Integration Testing	RATE LIMITING ENG...	TO DO	-	=	RG

Core features of Client Identification System and Rate Limiting Engine components must be ready and working.

Completed items: 5 (ARL-3, ARL-4, ARL-8, ARL-6, ARL-5)

To do items: 3 (ARL-20, ARL-37, ARL-36)

Remaining items: 31

# JIRA & SPRINT MANAGEMENT

## Backlog after Sprint 1

Screenshot of a Jira board titled "Backlog after Sprint 1". The board shows a backlog of 9 work items. The backlog tab is selected, and the "Summary" tab is also visible.

The backlog items are:

Key	Description	Assignee	Status	Priority	Due Date	Creator
ARL-7	Multiple Rate Limiting Algorithms	RATE LIMITING ENG...	To Do	8	=	RB
ARL-13	Send proactive alerts when clients approach configured rate limits	MONITORING & AN...	To Do	5	~	RG
ARL-14	Expose rate limit information in response headers to clients	MONITORING & AN...	To Do	3	^	RG
ARL-15	Real-time admin dashboard showing current request counts per client	MONITORING & AN...	To Do	8	^	RG
ARL-21	Design / Architecture		In Progress	-	~	RG
ARL-16	Update rate limit rules without service restarts	CONFIGURATION M...	To Do	8	~	RG
ARL-17	Validate configuration syntax & semantics before applying changes	CONFIGURATION M...	To Do	5	~	RG
ARL-18	Implement rule precedence	CONFIGURATION M...	To Do	5	=	RG
ARL-19	Allow admin to manually block sources temporarily	CONFIGURATION M...	To Do	5	~	RG

Filter buttons at the top of the backlog table include: Version, Epic, Type, and Quick filters. A "Create sprint" button is located in the top right corner of the backlog section.

# JIRA & SPRINT MANAGEMENT

## Sprint 2

raunakbagaria.atlassian.net/jira/software/c/projects/ARL/boards/67/backlog

Search  Upgrade

For you, Recent, Starred, Apps, Plans, Spaces, API Rate Limiter, ARL board, Summary, Timeline, Backlog (selected), Active sprints, Calendar, Reports, List, Forms, Goals, More 7, +

Search backlog, Version, Epic, Type, Quick filters

ARL Sprint 2 19 Oct – 4 Nov (8 work items)

Work Item	Description	Status	Priority	Assignee
ARL-20	Allow configurable custom error messages for blocked/rate-limited responses	DONE	5	RB
ARL-18	Implement rule precedence	DONE	5	JR
ARL-14	Expose rate limit information in response headers to clients	DONE	3	RG
ARL-16	Update rate limit rules without service restarts	DONE	8	JR
ARL-13	Send proactive alerts when clients approach configured rate limits	DONE	5	RS
ARL-19	Allow admin to manually block sources temporarily	DONE	8	RS
ARL-17	Validate configuration syntax & semantics before applying changes	DONE	5	RG
ARL-40	System Integration Testing	IN PROGRESS	-	RB

Backlog (4 work items)

Work Item	Description	Status	Priority	Assignee
ARL-37	Integration Testing	TO DO	-	RB

# JIRA & SPRINT MANAGEMENT

## Backlog after Sprint 2

☐ Backlog (4 work items)

16 0 0 Create sprint

<input checked="" type="checkbox"/> ARL-37 Integration Testing	CLIENT IDENTIFIC...	TO DO ▾	-	=	
<input type="checkbox"/> ARL-7 Multiple Rate Limiting Algorithms	RATE LIMITING EN...	TO DO ▾	8	=	
<input checked="" type="checkbox"/> ARL-36 Integration Testing	RATE LIMITING EN...	TO DO ▾	-	=	
<input type="checkbox"/> ARL-15 Real-time admin dashboard showing current request counts per client	MONITORING & A...	TO DO ▾	8	=	

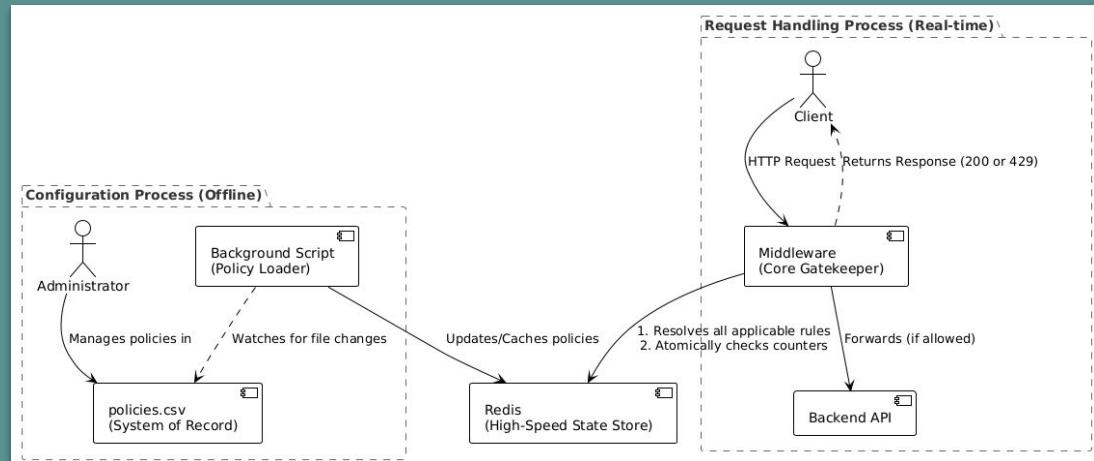
+ Create

We covered integration testing under ARL-40 in Sprint 2.

ARL-36 & 37 are duplicate tasks that were created earlier but we already covered those in ARL-40 and Jira wasn't allowing us to delete those.

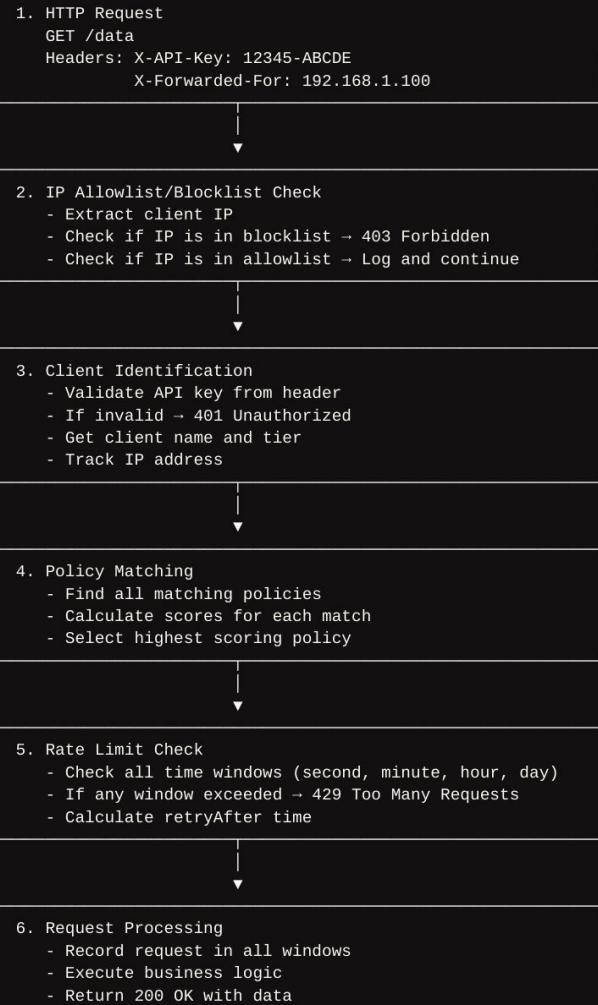
- ❑ The Middleware (Core Gatekeeper) intercepts all client requests.
- ❑ It checks the request against the In-Memory Store (Hash Maps), which holds both policies and live counters.
- ❑ If ALLOWED: Forwards the request to the Backend API.
- ❑ If DENIED: Returns a 429 Too Many Requests error.

### ❑ System Architecture (UML Diagram)

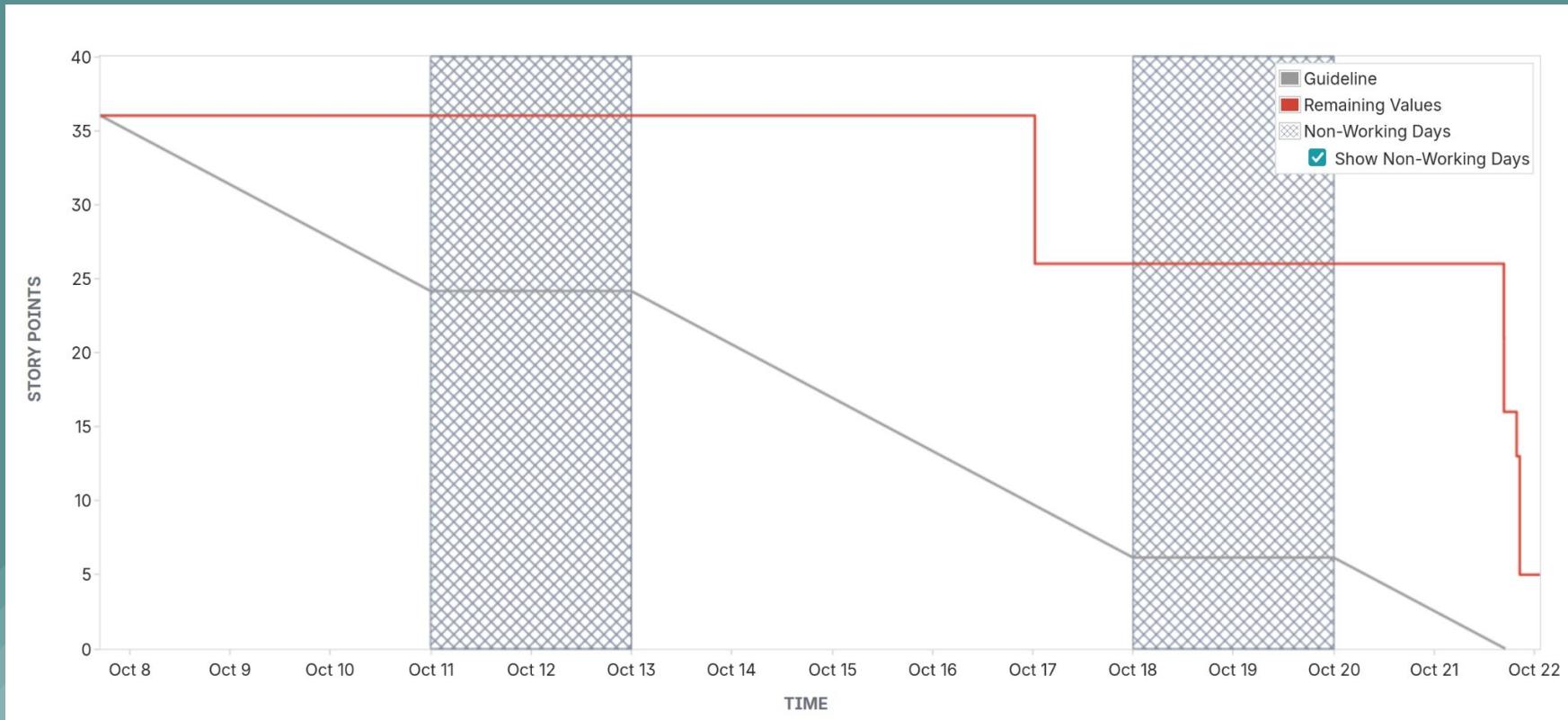


# Phase 3 : Implementation

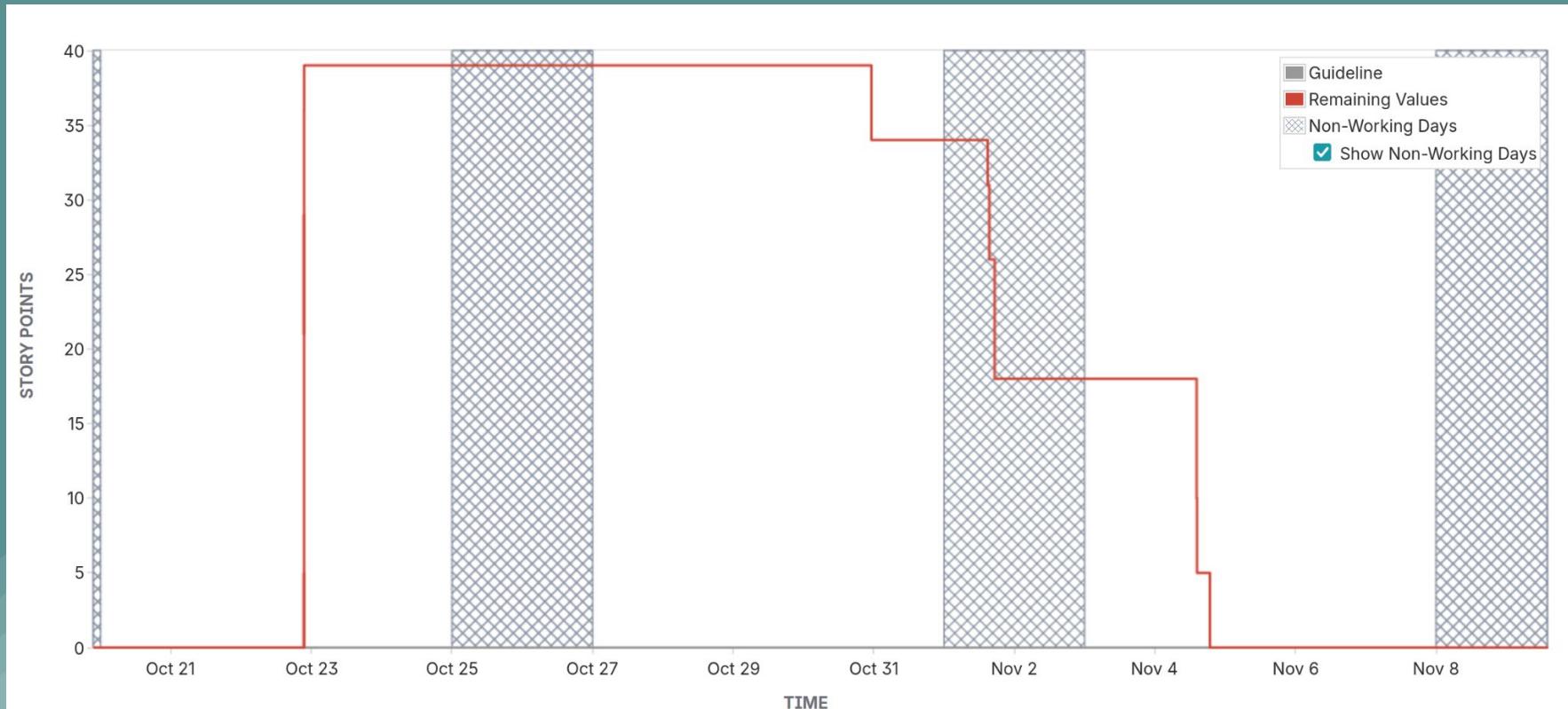
- ❑ Tech Stack : Node.js & Express
- ❑ Sprint 1 : 07/10/25 to 21/10/25
- ❑ Sprint 2 : 22/10/25 to 04/11/25



## ☐ Sprint 1 Burndown Chart



## Sprint 2 Burndown Chart



# Codebase with 72 commits

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 PESU\_RR\_CSE\_H\_P73\_API\_Rate\_Limiter\_Codevengers Private

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**About**

UE23CS341A Project: API Rate Limiter -  
RR CSE Section H Team Codevengers  
(Year 2025, 5th Sem). Project Description:  
A middleware or service that can be used  
to enforce rate limits on API endpoints ...

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[year-2025](#) [section-h](#) [p73](#) [codevengers](#)

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**API Rate Limiter**

## Directory Tree

📁 .github
📁 workflows
📄 ci-cd.yml
📄 CODEOWNERS
📁 docs
📄 ERROR_MESSAGES.md
📄 HOT_RELOAD.md
📄 RATE_LIMITER.md
📄 RULE_HIERARCHY.md
📄 Retrospective Doc.pdf
📄 SAD_Doc_Codevengers.docx.pdf
📄 SRS_Codevengers.pdf
📄 Sprint screenshots.pdf
📄 Test Plan.pdf
📄 api-identification.txt
📄 rate-limit-headers.md
📁 src
📁 __pycache__
📄 AlertManager.js
📄 RequestForwarder.js
📄 adminBlockManager.js
📄 apiKeyManager.js
📄 api_key_manager.py
📄 app.js
📄 app.py
📄 clientIdentifier.js
📄 client_cidr.csv
📄 client_ips.csv
📄 clients.csv
📄 configManager.js
📄 configurationValidator.js
📄 errorMessageManager.js
📄 error_messages.csv
📄 ipAllowBlockManager.js
📄 ipManager.js
📄 ip_allowlist.csv

| 📄 ip\_blocklist.csv |
| 📄 rateLimitHeaderManager.js |
| 📄 rateLimitPolicyManager.js |
| 📄 rateLimiter.js |
| 📄 rate\_limit\_policies.csv |
| 📁 tests |
| 📁 fixtures |
| 📁 integration |
| 📁 system |
| 📁 unit |
| 📄 setup.js |
| 📄 .gitignore |
| 📄 AlertManager.js |
| 📄 README.md |
| 📄 alertManager.test.js |
| 📄 eslint.config.js |
| 📄 jest.config.js |
| 📄 package-lock.json |
| 📄 package.json |



# Code Commits

## Commits

main

Commits on Nov 12, 2025

Merge pull request #22 from pestechology/documentation

roshithsharma authored 25 minutes ago · ✓ 6 / 6

Verified 565fb46

Add important docs

raunak-bagaria committed 38 minutes ago · ✓ 6 / 6

Verified 5e2d163

Commits on Nov 11, 2025

Merge pull request #21 from pestechology/system-integration

jeev1234 authored yesterday · ✓ 6 / 6

Verified 83abc9a

fix: Change name of deployment stage to a shorter name (deploy by default) for better visibility in github actions

raunak-bagaria committed yesterday · ✓ 12 / 12

Verified 975cff

fix: Add deploy stage to CI/CD to generate zipped deployment artifact

raunak-bagaria committed yesterday · ✓ 6 / 6

Verified 90fce6f

fix: Add warnings check (must be < 10) in lint stage, and fix ESLint dependency

raunak-bagaria committed yesterday · ✓ 5 / 5

Verified 0be97b6

fix: dependencies for lint report generation

raunak-bagaria committed yesterday · ✘ 3 / 5

Verified d6b13ad

fix: ci/cd to pass/fail coverage stage

raunak-bagaria committed yesterday · ✘ 3 / 5

Verified 277d12f

fix: compatibility with test reorganization

raunak-bagaria committed yesterday · ✘ 2 / 5

Verified 0899fc2

test: Refactored tests directory to organize unit, integration and system tests, and added some integration tests to improve coverage

raunak-bagaria committed yesterday

Verified abc6d94

fix: Add separate lint, coverage and security stages

raunak-bagaria committed yesterday

ed&cfb

Merge branch 'main' into system-integration

raunak-bagaria committed yesterday

357ee8a

Commits on Nov 10, 2025

Merge pull request #20 from pestechology/dev-jeevith

raunak-bagaria authored 2 days ago · ✓ 2 / 2

Verified 14a75bc

feat: increased the code coverage

jeev1234 committed 2 days ago · ✓ 1 / 2

92e1cd3

chore: Merge main into dev-jeevith

jeev1234 committed 2 days ago

cc31b22

Commits on Nov 9, 2025

Minor config changes for system integration testing

raunak-bagaria committed 3 days ago

daa3dd6

Add system integration tests

raunak-bagaria committed 3 days ago

de57187

Commits on Nov 5, 2025

(ARL 18) Merge pull request #17 from pestechology/feature/rule-hierarchy

raunak-bagaria authored last week · ✓ 2 / 2

Verified d3465d4

Commits on Nov 4, 2025

fix: remove duplicate RateLimitPolicyManager import

jeev1234 committed last week · ✓ 1 / 2

bfddef

fix: resolve all ESLint errors for clean CI/CD build

jeev1234 committed last week · ✘ 0 / 2

534bc3d

(ARL 19) Merge pull request #19 from pestechology/dev-roshit

raunak-bagaria authored last week · ✓ 2 / 2

Verified e1f757e

## Git Branching

Branch	Updated	Check status	Behind	Ahead	Pull request
main	19 hours ago	✓ 6 / 6	0	1	Default
feature/rate_limiter_engine	17 hours ago		0	1	
system-integration	20 hours ago	✓ 12 / 12	1	0	#21
dev-jeevith	2 days ago	✓ 1 / 2	14	0	#20
feature/rule-hierarchy	last week	✓ 1 / 2	26	0	#17
dev-rishav	last week	✓ 1 / 2	47	0	#18
dev-roshit	last week	✓ 1 / 2	35	0	#19
feature/dynamic-rate-limits	2 weeks ago	✗ 0 / 2	51	0	#13
feature/ip-allowlist-blocklist	3 weeks ago	✓ 1 / 2	61	0	#10
develop	3 weeks ago	✓ 2 / 4	60	0	#9
feature/client_identification	last month	✓ 1 / 2	64	0	#4
dev-raunak	last month		67	2	
testing	last month		67	2	

# Pull Requests

Code Issues Pull requests Actions Projects Wiki Security Insights Settings

Filters is:pr is:closed Labels 9 Milestones 0 New pull request

Clear current search query, filters, and sorts

Author	Label	Projects	Milestones	Reviews	Assignee	Sort
raunak-bagaria						0 Open ✓ 22 Closed
raunak-bagaria						Add important docs ✓ #22 by raunak-bagaria was merged 27 minutes ago • Approved
raunak-bagaria						System integration + CI/CD ✓ #21 by raunak-bagaria was merged yesterday • Approved
jeev1234						increasing code coverage ✓ #20 by jeev1234 was merged 2 days ago • Approved
rohit87sharma						Dev roshit ✓ #19 by rohit87sharma was merged last week • Approved
TOOISH12						eat(configurationValidator): implement validator and add tests ✓ #18 by TOOISH12 was merged last week • Approved
jeev1234						Rule precedence ✓ #17 by jeev1234 was merged last week • Approved
raunak-bagaria						ARL 20 (Allow custom error messages in rate-limited responses) + CI/CD build fixes ✓ #16 by raunak-bagaria was merged last week • Approved
rohit87sharma						Add files via upload ✘ #15 by rohit87sharma was merged 2 weeks ago • Approved
TOOISH12						feat: implement rate limit response headers (X-RateLimit-*) ✘ #14 by TOOISH12 was merged 2 weeks ago • Approved
jeev1234						feat: Allow rate limit updates without service restart ✘ #13 by jeev1234 was merged 2 weeks ago • Approved
raunak-bagaria						ARL-6 : Rate limit enforcement across clients and time windows ✘ #12 by raunak-bagaria was merged 2 weeks ago • Approved



## Sample Pull Request

Merged ARL 20 (Allow custom error messages in rate-limited responses) + CI/CD build fixes #16  
jeev1234 merged 5 commits into `main` from `feature/rate_lim...` last week

**raunak-bagaria** changed the title ARL 20 (Allow custom error messages in rate-limited responses) ARL 20 (Allow custom error messages in rate-limited responses) + CI/CD build fixes 2 weeks ago

**fix:** Remove mock integration test file that interferes with build ✓ `4c262a3`

**jeev1234** approved these changes last week [View reviewed changes](#)

**jeev1234** left a comment

This PR adds a well-structured rate-limiting feature with a clear separation between limiter logic, middleware, and application wiring; configuration values are externalized for easy tuning across environments; the code is readable with descriptive names and small functions that aid maintainability; basic logging is included to help diagnose throttling events; and the modular design makes it straightforward to swap or extend storage backends (e.g., in-memory for dev, Redis for production).

**jeev1234** merged commit `37c4e2b` into `main` last week  
2 checks passed [View details](#) [Revert](#)

**Pull request successfully merged and closed**  
You're all set — the branch has been merged.

## Phase 4 : Testing & QA

[Test Plan Doc](#)

### **Unit Tests**

For each module / feature.

### **Integration Tests**

Tested interactions between client identification, rate-limit calculation, and alert generation.

### **System Tests**

Tested how the system responds to real API requests, how limits are enforced, and how alerts are triggered when usage crosses 80% thresholds.

### **Static code analysis (ESLint)**

Used ESLint to detect syntax errors, unused variables, and style violations.

### **Code coverage**

Measured code coverage to check how much of our codebase is tested by our unit and integration tests. Enforced a >75% quality gate in CI/CD.

## Phase 4 : Testing & QA - Total Tests Run & Passed (336 test cases, 17 test suites)

```
at src/app.js:38:11
console.log
IP Check for ::ffff:127.0.0.1: none - IP address not in any list - process according to normal rules
at src/app.js:60:11

PASS  tests/system/system.integration.test.js
  System Integration
    ✓ health endpoint (52 ms)

-----| %Stmts | %Branch | %Funcs | %Lines | Uncovered Line #
-----|-----|-----|-----|-----|-----|
All files | 86.05 | 75.34 | 88.42 | 87.1 | 24,29,65
AlertManager.js | 80.64 | 48.48 | 37.5 | 88.46 | 18-29
RequestForwarder.js | 100 | 62.5 | 100 | 100 | 38,59,78
adminBlockManager.js | 93.5 | 59.45 | 100 | 95.52 | 62-63,82
apiKeyManager.js | 92.85 | 76.47 | 100 | 92.68 | 48-78,129,139,155,193,204-218
clientIdentifier.js | 59.18 | 55.55 | 50 | 59.18 | ...70,191,222-224,242-279,299-310,314,339,364-370,398,422-423,431-432,556,583-584
configManager.js | 75.37 | 63.76 | 78.12 | 75.64 | 304,424,435,458,483-491,504,515,555,643,654,794,841
configurationValidator.js | 91.6 | 83.04 | 100 | 94.86 | errorMessageManager.js | 94.11 | 81.08 | 100 | 95.23 | 97,142,178,200
ipAllowBlockManager.js | 92.98 | 88.88 | 100 | 93.86 | ipManager.js | 93.75 | 81.57 | 100 | 95.08 | 80,86,125,141,177,213
ipManager.js | 93.75 | 81.57 | 100 | 95.08 | rateLimitHeaderManager.js | 100 | 90.47 | 100 | 100 | 67,115
rateLimitPolicyManager.js | 78.96 | 76.31 | 82.92 | 78.74 | rateLimiter.js | 84.87 | 77.77 | 91.66 | 85.47 | ...34,343,364,423,441-443,493-516,528,541,558-562,708-709,717,750,758-759,767,784
rateLimiter.js | 84.87 | 77.77 | 91.66 | 85.47 | 126,380-409
===== Coverage summary =====
Statements : 86.05% ( 1321/1535 )
Branches   : 75.34% ( 712/945 )
Functions  : 88.42% ( 191/216 )
Lines      : 87.1% ( 1263/1450 )

===== Test Suites: 17 passed, 17 total =====
Tests:     1 skipped, 335 passed, 336 total
Snapshots: 0 total
Time:      7.149 s
Ran all test suites.
```

## Phase 4 : Testing & QA : Test Suites and Distribution

Test Type (Suites)	Created	Passed	Failed
Unit Tests (11)	281	281	0
Integration Tests (5)	54	54	0
System Tests (1)	1	1	0

# Phase 4 : Testing & QA - Code Coverage Report

## All files

89.9% Statements 1380/1535 78.73% Branches 744/945 94.44% Functions 204/216 91.03% Lines 1326/1450

Press *n* or *j* to go to the next uncovered block, *b*, *p* or *k* for the previous block.

Filter:

File ▲	Statements ▲	Branches ▲	Functions ▲	Lines ▲
AlertManager.js	<div><div style="width: 83.87%;">███████████</div></div>	83.87%	26/31	54.54%
RequestForwarder.js	<div><div style="width: 91.66%;">███████████</div></div>	91.66%	11/12	62.5%
adminBlockManager.js	<div><div style="width: 93.5%;">███████████</div></div>	93.5%	72/77	59.45%
apiKeyManager.js	<div><div style="width: 92.85%;">███████████</div></div>	92.85%	39/42	76.47%
clientIdentifier.js	<div><div style="width: 83.67%;">███████████</div></div>	83.67%	41/49	80%
configManager.js	<div><div style="width: 86.93%;">███████████</div></div>	86.93%	173/199	73.91%
configurationValidator.js	<div><div style="width: 91.6%;">███████████</div></div>	91.6%	251/274	83.04%
errorMessageManager.js	<div><div style="width: 94.11%;">███████████</div></div>	94.11%	80/85	79.72%
ipAllowBlockManager.js	<div><div style="width: 92.98%;">███████████</div></div>	92.98%	159/171	81.48%
ipManager.js	<div><div style="width: 93.75%;">███████████</div></div>	93.75%	120/128	81.57%
rateLimitHeaderManager.js	<div><div style="width: 100%;">███████████</div></div>	100%	39/39	90.47%
rateLimitPolicyManager.js	<div><div style="width: 86.73%;">███████████</div></div>	86.73%	268/309	83.77%
rateLimiter.js	<div><div style="width: 84.87%;">███████████</div></div>	84.87%	101/119	77.77%

# Complete CI/CD Pipeline

← CI-CD Pipeline

## ✓ Merge pull request #21 from pestechology/system-integration #52

Re-run all jobs

...

### Summary

Triggered via push 4 days ago

👤 jeev1234 pushed ↗ 83abc9a main

Status

Success

Total duration

2m 16s

Artifacts

8

#### Jobs

- ✓ build
- ✓ test
- ✓ coverage
- ✓ lint
- ✓ security
- ✓ deploy

### ci-cd.yml

on: push



#### Run details

⌚ Usage

📦 Workflow file



# CI/CD Pipeline : Artifacts

[Summary](#)

Jobs

- build
- test
- coverage
- lint
- security
- deploy

Run details

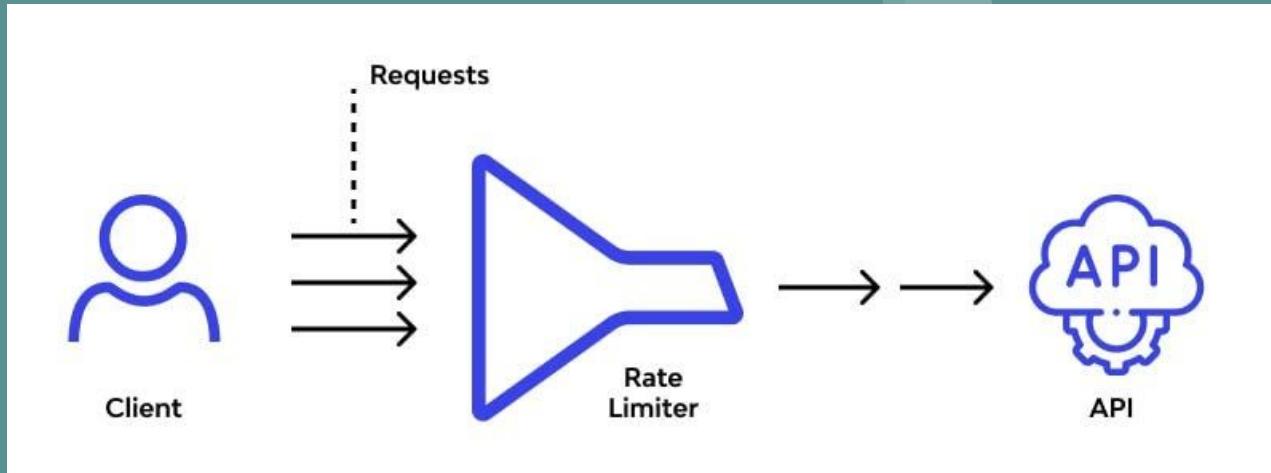
- Usage
- Workflow file

## Artifacts

Produced during runtime

Name	Size	Digest	Actions
coverage-data	11 KB	sha256:dbd6b5758f83c67c2915d69f0e423f...	<a href="#">Download</a> <a href="#">Delete</a> <a href="#">Unzip</a>
coverage-raw	236 KB	sha256:d634c5ac927c47493e70eba4c92f78...	<a href="#">Download</a> <a href="#">Delete</a> <a href="#">Unzip</a>
coverage-report-html	112 KB	sha256:b3497f141ba393bea95c27db99ec7b...	<a href="#">Download</a> <a href="#">Delete</a> <a href="#">Unzip</a>
deployment-package	248 KB	sha256:a6caf71caf00ab31f770a5538d70eb...	<a href="#">Download</a> <a href="#">Delete</a> <a href="#">Unzip</a>
lint-report	14.3 KB	sha256:9ef34c0545ee4454430977cb2ad8b5...	<a href="#">Download</a> <a href="#">Delete</a> <a href="#">Unzip</a>
node-modules	12.9 MB	sha256:b54909e757cb8e2d60ab78d04fbfe5...	<a href="#">Download</a> <a href="#">Delete</a> <a href="#">Unzip</a>
security-reports	3.04 KB	sha256:40a29e83d56e50547eda4c1f7124c2...	<a href="#">Download</a> <a href="#">Delete</a> <a href="#">Unzip</a>
test-results	6.29 KB	sha256:fa797f627cd85298ddf1a5ab084d2...	<a href="#">Download</a> <a href="#">Delete</a> <a href="#">Unzip</a>

# DEMO



## Screenshots

# Server

```
raunak@hp-15s:~/Desktop/PESU/Sem5/SE/SE_Project/PESU_RR_CSE_H_P73_API_Rate_Limiter_Codevengers$ npm start
> pesu_rr_cse_h_p73_api_rate_limiter_codevengers@1.0.0 start
> node src/app.js

Loaded 3 API key clients
Loaded 6 CIDR ranges for 3 clients
Loaded 16 learned IP addresses
Loaded 4 entries in IP allowlist
Loaded 5 entries in IP blocklist
ClientIdentifier initialized with 3 API key clients
Loaded 4 entries in IP allowlist
Loaded 5 entries in IP blocklist
RateLimiter initialized with multi-window enforcement
Loaded 4 custom error messages
Initial config loaded: 3 entries (version: 1763301152378)
Starting config file watcher for: /home/raunak/Desktop/PESU/Sem5/SE/SE_Project/PESU_RR_CSE_H_P73_API_Rate_Limiter_Codevengers/src/rate_limit_policies.cs
v
Config watcher started successfully
ConfigManager initialized (watching: true)
Config watcher already started
Hot-reload enabled for rate limit policies
Rate limit policy manager initialized with hot-reload enabled
=====
API Rate Limiter Starting
API Key Clients: 3
CIDR Ranges: 6 (3314 requests)
Learned IPs: 16 (1184 requests)
IP Allowlist: 4 entries (0 requests)
IP Blocklist: 5 entries (45 requests)
Server running on port 3000
=====

[2025-11-16T13:55:45.576Z] GET /health
Headers: X-API-Key=missing, IP=:1
IP Check for ::1: none - IP address not in any list - process according to normal rules

[2025-11-16T13:56:05.974Z] GET /data
Headers: X-API-Key=missing, IP=:1
IP Check for ::1: none - IP address not in any list - process according to normal rules
Unauthorized request from ::1: API key is required. Please provide X-API-Key header.
```

## 1. Basic Request

```
raunak@hp-15s:~$ curl -s http://localhost:3000/data | jq
{
  "valid": false,
  "error": {
    "message": "Unauthorized request. Invalid or missing API key. Please provide a valid X-API-Key header. Contact support@api-rate-limiter.com for API access."
  }
}
```

```
raunak@hp-15s:~$ curl -s -H "X-API-Key: 12345-ABCDE" http://localhost:3000/data | jq
{
  "message": "Welcome Client A",
  "classification": "free",
  "clientIP": "::1"
}
```

## 2. Tier-based Access Control

```
raunak@hp-15s:~$ curl -s -H "X-API-Key: 12345-ABCDE" http://localhost:3000/premium-only | jq
{
  "error": {
    "message": "Access denied. This endpoint requires premium or higher tier or higher. Your current
tier is free. Contact support@api-rate-limiter.com to upgrade your account.",
    "yourTier": "free",
    "requiredTier": "premium or higher"
  }
}
```

```
raunak@hp-15s:~$ curl -s -H "X-API-Key: 67890-ZYXWV" http://localhost:3000/premium-only | jq
{
  "message": "Welcome to premium features",
  "data": "premium content here",
  "client": "Client B"
}
```

## Screenshots

2 requests are sent within 1 second.

API Key 12345-ABCDE is the free tier, hence the first request succeeds but the second request is rejected with HTTP 429.

### Default Limits by Tier:

Tier	Per Second	Per Minute	Per Hour	Per Day
Free	1	10	100	1,000
Basic	5	50	500	5,000
Standard	10	100	1,000	10,000
Premium	50	500	5,000	50,000
Enterprise	100	1,000	10,000	100,000

## 3. Multi-Window Rate Limiting

```
raunak@hp-15s: $ for i in {1..2}; do
    curl -s -H "X-API-Key: 12345-ABCDE" http://localhost:3000/data | jq;
done
{
  "message": "Welcome Client A",
  "classification": "free",
  "clientIP": "::1"
}
{
  "error": {
    "message": "Rate limit exceeded for second window. You have made 1 requests out of 1 allowed. Please wait 1 seconds before retrying. Contact support@api-rate-limiter.com for assistance.",
    "limitingWindow": "second",
    "retryAfter": 1,
    "windows": {
      "second": {
        "allowed": false,
        "currentCount": 1,
        "limit": 1,
        "remainingRequests": 0
      },
      "minute": {
        "allowed": true,
        "currentCount": 2,
        "limit": 10,
        "remainingRequests": 8
      },
      "hour": {
        "allowed": true,
        "currentCount": 13,
        "limit": 100,
        "remainingRequests": 87
      },
      "day": {
        "allowed": true,
        "currentCount": 13,
        "limit": 1000,
        "remainingRequests": 987
      }
    }
  }
}
```

## 4. Live Rate Limit changes (Hot Reload)

Rate Limit updated without pause in service

```
raunak@hp-15s:~$ curl -s http://localhost:3000/admin/rate-limits/tier/free | jq

{
  "tier": "free",
  "limits": {
    "second": 1,
    "minute": 10,
    "hour": 100,
    "day": 1000
  }
}
raunak@hp-15s:~$ curl -s -X PUT http://localhost:3000/admin/rate-limits/tier/free
-H "Content-Type: application/json" -d '{"second": 5}' | jq
{
  "message": "Updated rate limits for tier: free",
  "tier": "free",
  "limits": {
    "second": 5,
    "minute": 10,
    "hour": 100,
    "day": 1000
  }
}
raunak@hp-15s:~$ curl -s http://localhost:3000/admin/rate-limits/tier/free | jq

{
  "tier": "free",
  "limits": {
    "second": 5,
    "minute": 10,
    "hour": 100,
    "day": 1000
  }
}
```

## Screenshots

# 5. Policy-Based Rules

```
raunak@hp-15s:~$ curl -s http://localhost:3000/admin/policies | jq
{
  "version": {
    "version": 1763301152378,
    "timestamp": 1763301152378,
    "appliedAt": "2025-11-16T13:52:32.378Z",
    "healthy": true,
    "configHash": "39320ceb"
  },
  "totalPolicies": 3,
  "policies": [
    {
      "id": "1",
      "endpoint": "/data",
      "api_key": "12345-ABCDE",
      "ip_or_cidr": "",
      "tier": "premium",
      "limit": "100",
      "window": "60"
    },
    {
      "id": "2",
      "endpoint": "/tier-info",
      "api_key": "",
      "ip_or_cidr": "",
      "tier": "free",
      "limit": "10",
      "window": "60"
    },
    {
      "id": "3",
      "endpoint": "/premium-only",
      "api_key": "",
      "ip_or_cidr": "192.168.1.0/24",
      "tier": "",
      "limit": "50",
      "window": "60"
    }
  ]
}
```

```
> rate_limit_policies.csv
1 id,endpoint,api_key,ip_or_cidr,tier,limit,wind
2 1,/data,12345-ABCDE,,premium,70,60
3 2,/tier-info,,,free,10,60
4 3,/premium-only,,192.168.1.0/24,,50,60
5
```

```
raunak@hp-15s:~$ curl -s http://localhost:3000/admin/policies | jq
{
  "version": {
    "version": 1763305916067,
    "timestamp": 1763305916067,
    "appliedAt": "2025-11-16T15:11:56.067Z",
    "healthy": true,
    "configHash": "764e94bd"
  },
  "totalPolicies": 3,
  "policies": [
    {
      "id": "1",
      "endpoint": "/data",
      "api_key": "12345-ABCDE",
      "ip_or_cidr": "",
      "tier": "premium",
      "limit": "70",
      "window": "60",
      "priority": "0"
    },
    {
      "id": "2",
      "endpoint": "/tier-info",
      "api_key": "",
      "ip_or_cidr": "",
      "tier": "free",
      "limit": "10",
      "window": "60",
      "priority": "0"
    },
    {
      "id": "3",
      "endpoint": "/premium-only",
      "api_key": "",
      "ip_or_cidr": "192.168.1.0/24",
      "tier": "",
      "limit": "50",
      "window": "60",
      "priority": "0"
    }
  ]
}
```

## Screenshots

## 6. IP Blocklist in action

```
raunak@hp-15s:~$ curl -s -H "X-API-Key: 12345-ABCDE" \
-H "X-Forwarded-For: 203.0.113.52" \
http://localhost:3000/data | jq
{
  "message": "Welcome Client A",
  "classification": "free",
  "clientIP": "203.0.113.52"
}

raunak@hp-15s:~$ curl -s -X POST http://localhost:3000/admin/blocklist/add \
-H "Content-Type: application/json" \
-d '{"ip_or_cidr": "203.0.113.52", "description": "suspicious"}' | jq
{
  "message": "Added 203.0.113.52 to blocklist",
  "ip_or_cidr": "203.0.113.52",
  "description": "suspicious"
}

raunak@hp-15s:~$ curl -s -H "X-API-Key: 12345-ABCDE" \
-H "X-Forwarded-For: 203.0.113.52" \
http://localhost:3000/data | jq
{
  "error": {
    "message": "Access denied. Your IP address (203.0.113.52) has been blocked.
If you believe this is an error please contact support@api-rate-limiter.com."
  },
  "reason": "IP address is blocklisted",
  "clientIP": "203.0.113.52"
}
```

### Server

```
[2025-11-16T15:17:54.576Z] GET /data
Headers: X-API-Key=***, IP=:1
Saved 7 blocklist entries
IP Check for 203.0.113.52: block - IP address is blocklisted
🚫 Blocked request from 203.0.113.52: IP address is blocklisted
```

## Screenshots

# 7. Admin Stats (Live Monitoring)

```
raunak@hp-15s:~$ curl -s http://localhost:3000/admin/stats | jq
{
  "apiKeyClients": 3,
  "cidr": {
    "totalRanges": 6,
    "totalRequests": 3314,
    "byClient": {
      "Client A": {
        "ranges": 2,
        "requests": 339
      },
      "Client B": {
        "ranges": 2,
        "requests": 579
      },
      "Client C": {
        "ranges": 2,
        "requests": 2396
      }
    }
  },
  "learnedIPs": {
    "totalIPs": 18,
    "totalRequests": 1222,
    "byClient": {
      "Client A": {
        "ips": 15,
        "requests": 484
      },
      "Client B": {
        "ips": 2,
        "requests": 195
      },
      "Client C": {
        "ips": 1,
        "requests": 543
      }
    }
  },
  "ipLists": {
    "allowlist": {
      "totalEntries": 4,
      "ipEntries": 2,
      "cidrEntries": 2,
      "totalRequests": 0
    },
    "blocklist": {
      "totalEntries": 6,
      "ipEntries": 3,
      "cidrEntries": 3,
      "totalRequests": 45
    }
  },
  "rateLimits": {
    "totalClients": 2,
    "clients": {
      "Client A": {
        "second": {
          "currentCount": 0,
          "limit": 1,
          "remainingRequests": 1
        },
        "minute": {
          "currentCount": 0,
          "limit": 10,
          "remainingRequests": 10
        },
        "hour": {
          "currentCount": 13,
          "limit": 100,
          "remainingRequests": 87
        },
        "day": {
          "currentCount": 15,
          "limit": 1000,
          "remainingRequests": 985
        }
      },
      "Client B": {
        "second": {
          "currentCount": 0,
          "limit": 50,
          "remainingRequests": 50
        },
        "minute": {
          "currentCount": 0,
          "limit": 500,
          "remainingRequests": 500
        },
        "hour": {
          "currentCount": 2,
          "limit": 5000,
          "remainingRequests": 4998
        },
        "day": {
          "currentCount": 3,
          "limit": 50000,
          "remainingRequests": 49997
        }
      }
    }
  }
}
```

```
"BLOCKLIST": {
  "totalEntries": 6,
  "ipEntries": 3,
  "cidrEntries": 3,
  "totalRequests": 45
},
"rateLimits": {
  "totalClients": 2,
  "clients": {
    "Client A": {
      "second": {
        "currentCount": 0,
        "limit": 1,
        "remainingRequests": 1
      },
      "minute": {
        "currentCount": 0,
        "limit": 10,
        "remainingRequests": 10
      },
      "hour": {
        "currentCount": 13,
        "limit": 100,
        "remainingRequests": 87
      },
      "day": {
        "currentCount": 15,
        "limit": 1000,
        "remainingRequests": 985
      }
    },
    "Client B": {
      "second": {
        "currentCount": 0,
        "limit": 50,
        "remainingRequests": 50
      },
      "minute": {
        "currentCount": 0,
        "limit": 500,
        "remainingRequests": 500
      },
      "hour": {
        "currentCount": 2,
        "limit": 5000,
        "remainingRequests": 4998
      },
      "day": {
        "currentCount": 3,
        "limit": 50000,
        "remainingRequests": 49997
      }
    }
  }
},
```

# Thank You

