Introduction to REST Architecture

REST (Representational State Transfer) was defined by Roy Fielding in 2000. It's an architectural style for distributed systems, not a standard.

The REST approach powers most modern web and mobile applications. It provides a flexible framework for API development with broad industry adoption.

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History and Evolution of REST

1

2000: Inception

Roy Fielding introduced REST in his PhD dissertation at UC Irvine.

2

2005–2010: Early Adoption

Companies began shifting from SOAP to REST. Adoption grew 300% during this period.

3

2010–Present: Dominance

REST now powers 70% of public APIs. SOAP usage declined to less than 15%.

What Makes REST Unique?

Stateless Communication

Each request contains all information needed. No client context is stored on server.

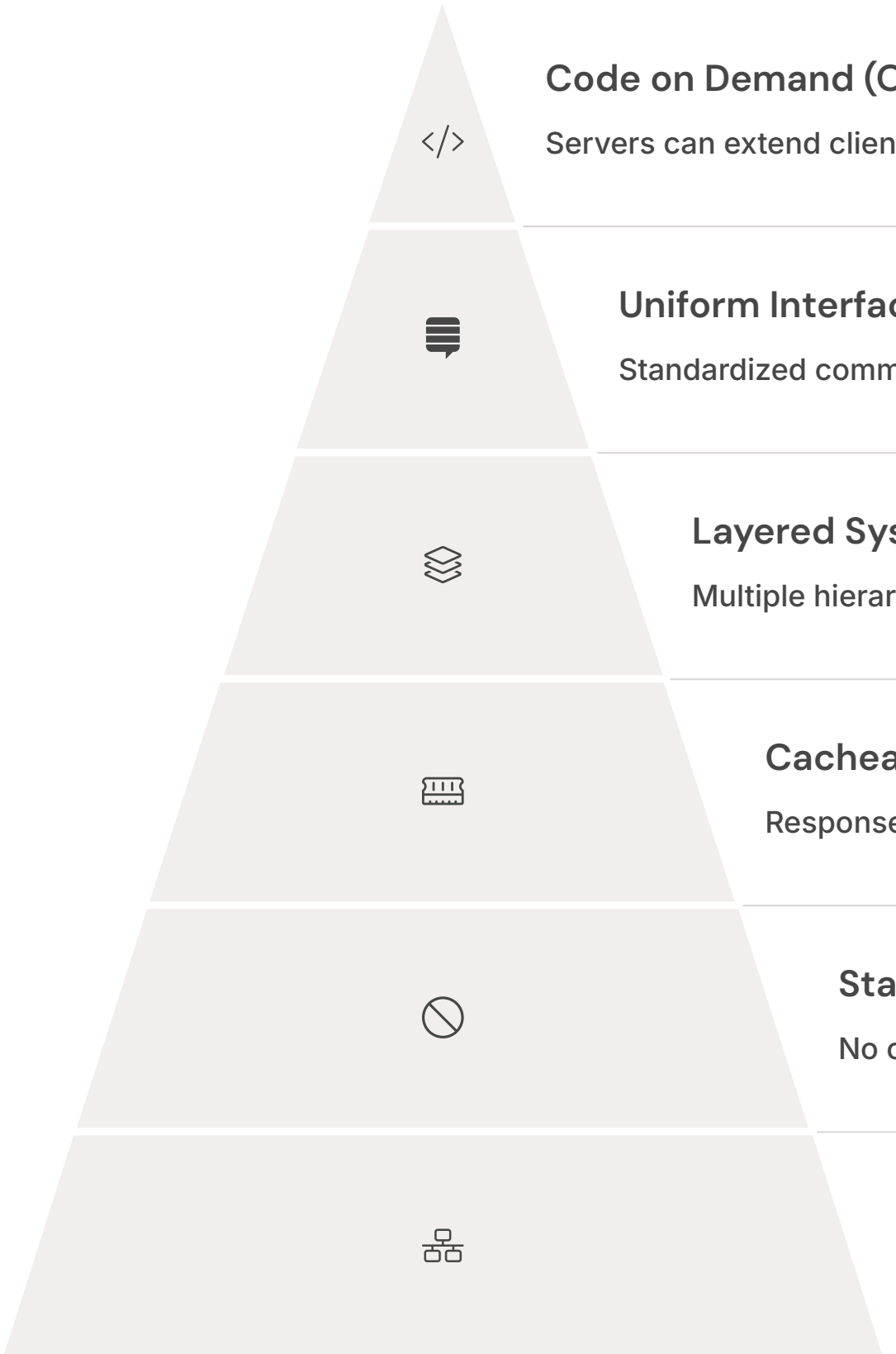
Uniform Interface

Standardized interactions between clients and servers. Simplified architecture.

Resource-Based

Everything is a resource with a unique URI. Data management becomes intuitive.

REST Architectural Constraints



Code on Demand (Optional)

Servers can extend client functionality by sending code

Uniform Interface

Standardized communication between components

Layered System

Multiple hierarchical layers with specific responsibilities

Cacheable

Responses explicitly labeled as cacheable or non-cacheable

Stateless

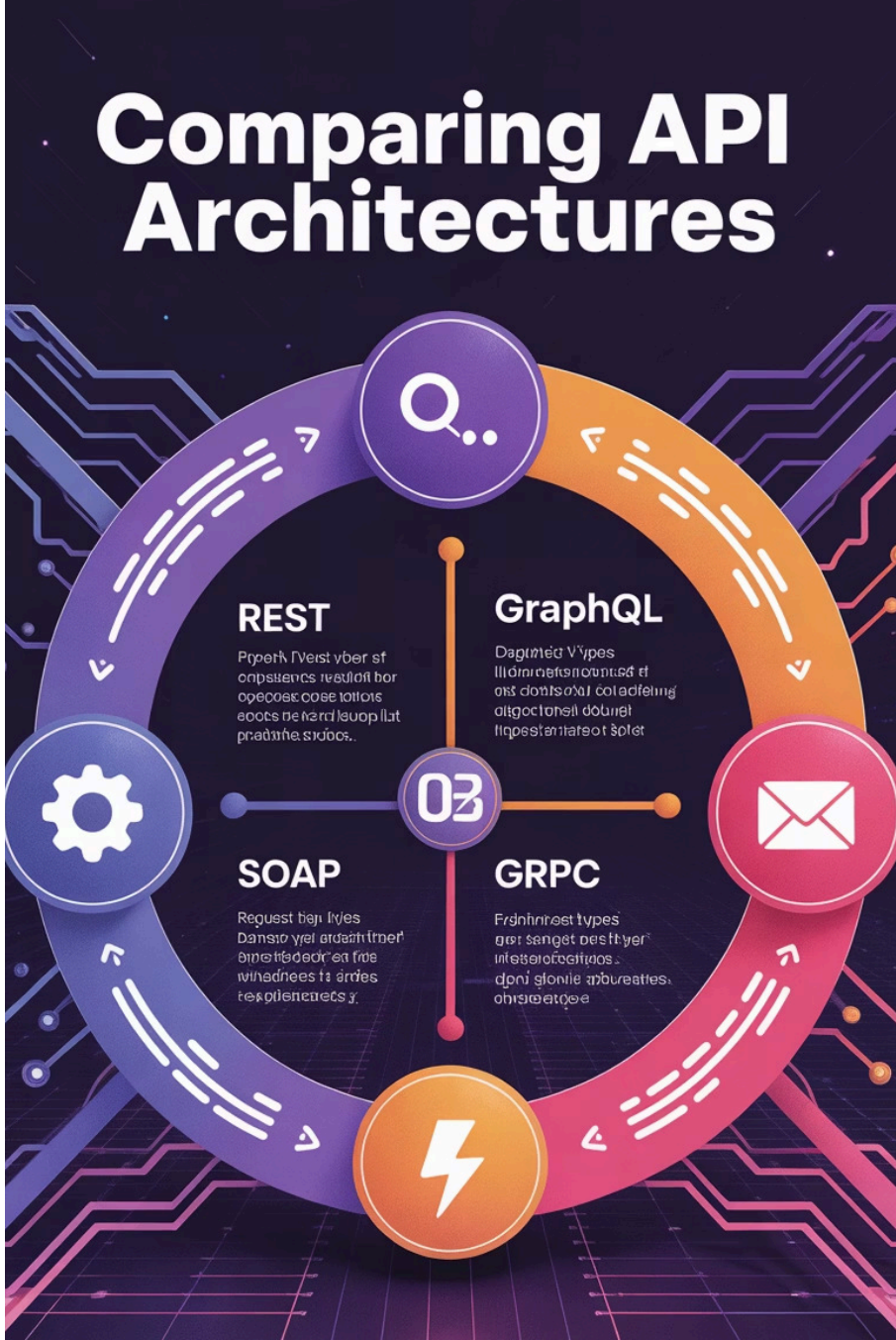
No client context stored between requests

Client-Server

Separation of concerns between user interface and data storage

REST vs. Other API Styles

API Style	Data Exchange	Complexity	Market Share
REST	Multiple endpoints	Medium	70%+
SOAP	XML only	High	~15%
GraphQL	Single endpoint	Medium	~10%
gRPC	Protocol buffers	High	~5%



Core Components of REST

Resources & URIs

Uniquely identified entities accessible via URI paths.

- Examples: /users, /products/123
- Represents any information that can be named

HTTP Verbs

Standard methods to interact with resources.

- GET, POST, PUT, DELETE, PATCH
- Each has specific purpose and behavior

Representations

Format of data exchanged between client and server.

- JSON (most common)
- XML, HTML, plain text

HTTP Methods in RESTful APIs

GET

- Retrieves resources
- Safe method (read-only)
- Idempotent (same result regardless of frequency)
- Example: GET /users/123

POST

- Creates new resources
- Not safe (modifies state)
- Not idempotent (creates new resource each time)
- Example: POST /users

PUT

- Updates existing resources
- Not safe (modifies state)
- Idempotent (same result with multiple calls)
- Example: PUT /users/123

DELETE

- Removes resources
- Not safe (modifies state)
- Idempotent (resource remains deleted)
- Example: DELETE /users/123

RESTful URL Design Best Practices

Resource Naming

Use nouns, not verbs for resources.

- Good: /users
- Bad: /getUsers

Use plural nouns for collections.

- Good: /products
- Bad: /product

Query Parameters

Use for filtering, sorting, and pagination.

- /products?category=electronics
- /users?sort=name&order=asc
- /posts?page=2&limit=10

API Versioning

Common strategies:

- URI path: /v1/users
- Header: Accept: application/vnd.company.v1+json
- Query parameter: /users?version=1

Data Representation: JSON vs. XML

JSON

JavaScript Object Notation

- Lighter weight, less verbose
- Native JavaScript support
- Used by >90% of REST APIs
- Human-readable format

XML

eXtensible Markup Language

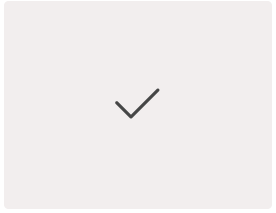
- More verbose, stricter validation
- Better for document-oriented data
- Used by enterprise systems
- Supports namespaces

Usage Trends

Market adoption

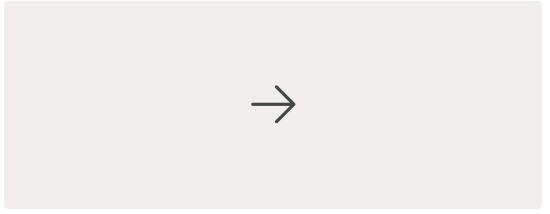
- JSON: Rising (90%+)
- XML: Declining (<10%)
- JSON preferred for mobile apps
- XML retained in legacy systems

Response Codes and Error Handling



2xx: Success

Request was successfully received, understood, and accepted

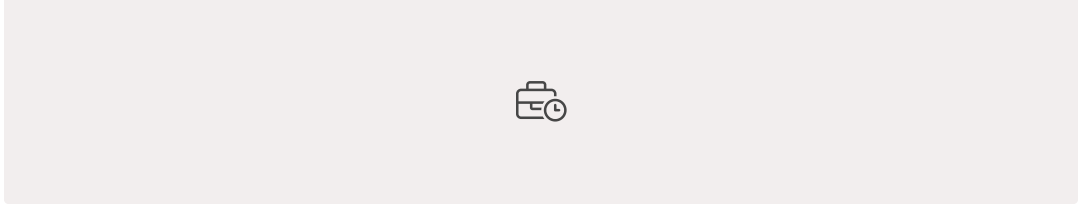


3xx: Redirection

Further action needed to complete the request

4xx: Client Error

Request contains bad syntax or cannot be fulfilled



5xx: Server Error

Server failed to fulfill a valid request

Effective error messages should include a status code, message, and details. Error responses should follow a consistent format across the API.

Authentication and Security in REST APIs

Basic Authentication

- Simple username/password in header
- Must use HTTPS for security
- Limited protection, better for development

API Keys

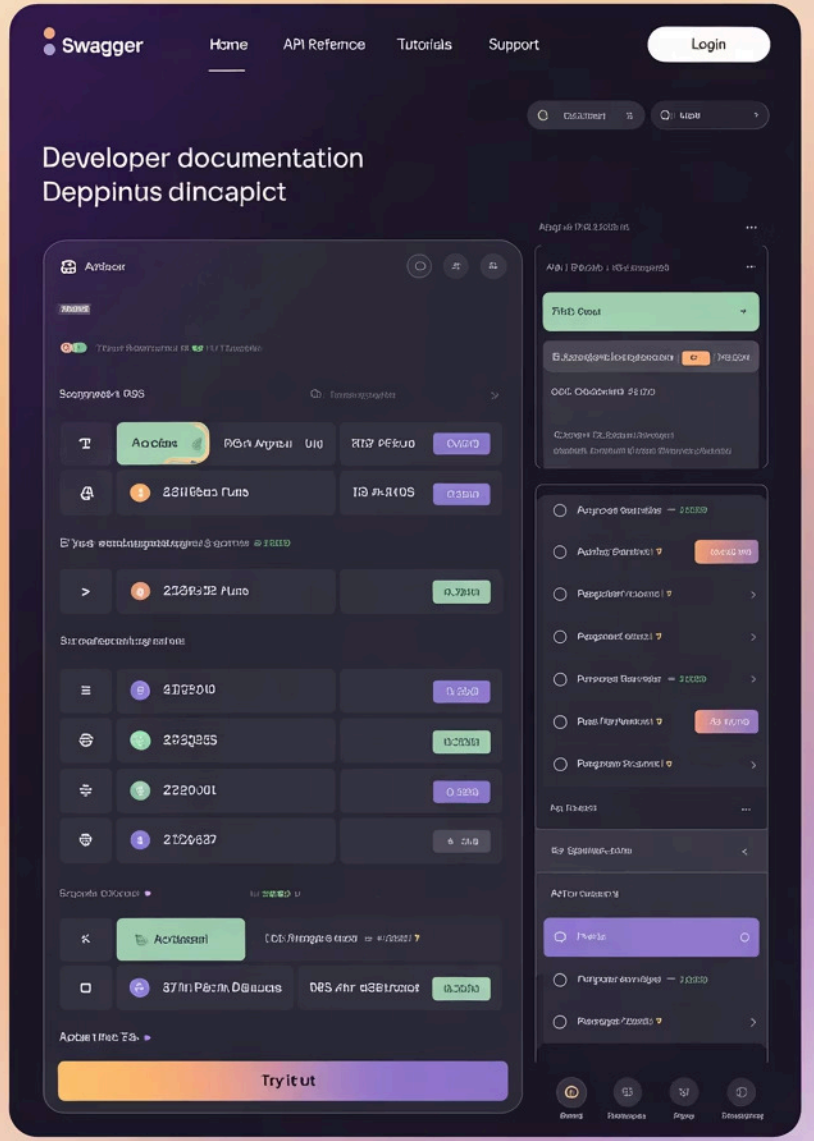
- Long, unique tokens in header or query
- Simple to implement
- Good for public APIs

OAuth 2.0

- Token-based authorization framework
- Delegates user authentication
- Industry standard for API security

JWT (JSON Web Tokens)

- Self-contained tokens with encoded claims
- Stateless authentication
- Efficient for microservices



REST API Documentation and Testing

80%

Developer Productivity

Improvement with good API documentation

41%

API Success Rate

APIs fail without proper documentation

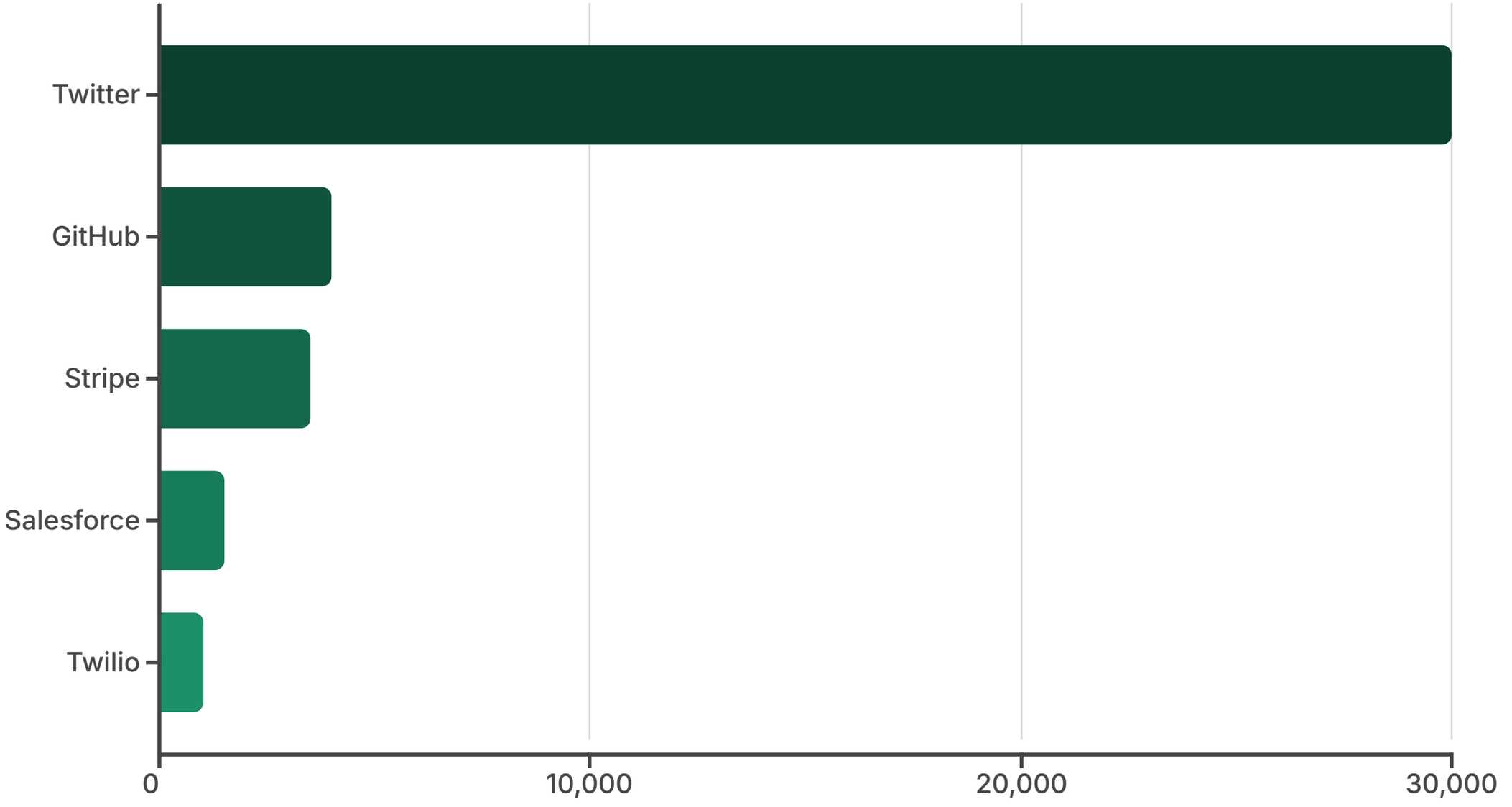
89%

Developers

Prefer interactive documentation

Popular tools include Swagger/OpenAPI for documentation and Postman for testing. Well-documented examples include Stripe, GitHub, and Twitter APIs.

Real-world Examples of REST APIs



These popular APIs showcase REST principles at scale. Twitter's REST API handles billions of daily requests across endpoints for tweets, users, and trends.

Common Pitfalls and Best Practices

Performance

Implement proper caching. Use ETags and Cache-Control headers.

Over/Under-fetching

Balance endpoint granularity. Consider resource expansion parameters.

Security

Always use HTTPS. Implement rate limiting.

Versioning

Plan for API evolution. Maintain backward compatibility.

Conclusion and Future of REST

REST's Legacy

Transformed web development. Enabled the API economy.

Current State

Industry standard. Powers most public APIs worldwide.

Future Trends

Coexisting with GraphQL. Integration with event-driven architectures.

Key Takeaways

Simplicity and flexibility explain REST's continued dominance.