

# Enterprise-Grade API & SDK Documentation Platform for Developer Enablement, Cloud-Scale Systems, and Agent Readiness

## Overview

**QuantumConnect API** is a high-speed communication tool that performs transactions with **incredibly low latency** and is scalable and secure. It is created to be used in **backend applications that require high performance**, and, as such, it supports **RESTful, GraphQL, and gRPC protocols**. This allows for effortless compatibility between **microservices, edge computing environments, and AI-driven pipelines**.

## Key Features:

- **End-to-end encryption (AES-256 + RSA-4096)** for sensitive enterprise data.
- **Real-time event streaming via WebSockets, Kafka, and MQTT bridges.**
- **Multi-region failover** for high availability (HA) with <1ms recovery SLA.
- **Dynamic rate-limiting** per API key with **AI-driven anomaly detection**.
- **OAuth 2.1 & OpenID Connect compliance**, with support for JWT signing and verification.
- **Semantic versioning** for backward compatibility: v1 (deprecated), v2 (stable), v3 (current).

---

## Authentication & Authorization

### OAuth 2.1 Bearer Token Authentication

QuantumConnect implements **stateless JWT-based authentication** with configurable expiration and rotation policies:

## Request Header Example:

GET /v3/resources/data HTTP/1.1

Host: api.quantumconnect.com

Authorization: Bearer <YOUR\_ACCESS\_TOKEN>

Content-Type: application/json

## Token Validation Flow:

1. Client requests an access token via /auth/token.
2. Token payload is signed using **RSA-4096 asymmetric encryption**.
3. On each API request, token signature and claims (exp, iat, scope) are verified.
4. Invalid or expired tokens return HTTP 401 Unauthorized with detailed error codes.

## Advanced Notes:

- **JWT Key Rotation** supports **automatic fetching of public keys via JWKs** endpoint.
  - Scope-based access ensures **least privilege access** for multi-tenant applications.
  - Supports **mutual TLS** for highly secure B2B integrations.
- 

## Rate Limiting & Throttling

- **Dynamic Rate Limits:** Adjust in real-time based on traffic patterns using ML-based predictive throttling.
- **Headers for Monitoring:**

X-RateLimit-Limit: 1000

X-RateLimit-Remaining: 750

X-RateLimit-Reset: 1695366000

- **Burst Traffic Handling:** Supports **token bucket algorithm** for sudden spikes, with **graceful degradation**.
-

# Endpoints

## 1. Data Retrieval

**GET /v3/resources/data** – Fetch real-time structured and unstructured data.

### Query Parameters:

- `start_time` (ISO8601) – Filter events after timestamp.
- `end_time` (ISO8601) – Filter events before timestamp.
- `type` (enum: metric, event, log) – Specify resource type.
- `region` (string) – Multi-region data selection.

### Response Example:

```
{
  "status": "success",
  "data": [
    {
      "id": "evt_00928ab",
      "type": "metric",
      "payload": {
        "cpu_usage": 0.82,
        "memory_mb": 1024,
        "latency_ms": 1.2
      },
      "timestamp": "2025-09-22T00:00:00Z"
    }
  ],
  "meta": {
    "request_id": "req_78a9d12",
```

```
"region": "us-east-1"
}
}
```

### Advanced Features:

- Supports **JSON-LD** for semantic web integration.
  - Returns **delta-based payloads** to reduce bandwidth.
  - Optional **hypermedia controls** (\_links) for HATEOAS compliance.
- 

## 2. Event Streaming

**WebSocket Endpoint:** wss://api.quantumconnect.com/v3/stream

### Connection Payload:

```
{
  "auth_token": "<JWT_ACCESS_TOKEN>",
  "channels": ["metrics", "alerts", "audit_logs"],
  "filters": {"severity": ["critical", "warning"]}
}
```

- Supports **QoS 0–2 levels** (MQTT semantics) for reliability.
  - **Backpressure-aware streaming** ensures no dropped events in high-load conditions.
  - Integrates with **Kafka Connect** for enterprise event pipelines.
- 

## 3. Advanced Query API

**POST /v3/query/execute** – Execute complex queries across multiple datasets.

### Payload Example:

```
{
```

```
"query": "SELECT cpu_usage, memory_mb FROM metrics WHERE region='us-east-1' AND timestamp > NOW()-1h",
```

```
"format": "parquet",
```

```
"priority": "high"
```

```
}
```

- Supports **vectorized queries** for AI/ML workloads.
- Returns **columnar formats** (Parquet, Arrow) for analytics efficiency.
- Optional **asynchronous execution** with `job_id` for long-running queries.

---

## Error Codes & Troubleshooting

Code Description		Recommended Action
400	Bad Request	Validate payload & query parameters
401	Unauthorized	Check JWT, scopes, token expiration
403	Forbidden	Ensure role-based permissions
429	Too Many Requests	Wait or request rate-limit increase
500	Internal Server Error	Retry with exponential backoff
503	Service Unavailable	Check multi-region failover status

### Pro Tip for MAANG-Level Applications:

Include **correlation ID** (`request_id`) and **distributed tracing headers** for full observability using **OpenTelemetry** and **Jaeger**.

---

## SDK & Integration Guides

QuantumConnect provides **official SDKs**:

- **Python 3.11+** – `pip install quantumconnect-sdk`
- **Node.js 20+** – `npm install quantumconnect`

- **Java 21+** – Maven artifact `com.quantumconnect:client:3.2.0`

### Example Python Integration:

```
from quantumconnect import QuantumClient
```

```
client = QuantumClient(api_key="YOUR_KEY", region="us-east-1")
```

```
metrics = client.get_data(type="metric", start_time="2025-09-22T00:00:00Z")
```

```
print(metrics)
```

- Supports **async/await**, **retry policies**, and **circuit breaker patterns**.
  - Optimized for **serverless and edge deployments**, including **AWS Lambda & Cloudflare Workers**.
- 

## Advanced Security & Compliance

- **HIPAA, SOC2, ISO27001** compliant data storage.
  - **Field-level encryption** for PII and sensitive metadata.
  - Optional **federated identity provider integration** for SSO.
  - Built-in **audit logging** for forensic analysis.
- 

## Performance & Scalability

- **Sub-millisecond latency** for core API endpoints.
  - Horizontal scaling using **Kubernetes autoscaling & service mesh (Istio)**.
  - Multi-region **read replicas** with **eventual consistency fallback**.
-

## Changelog

**v3.2** – Advanced streaming and semantic query support, enhanced security.

**v3.1** – Added WebSocket backpressure handling and QoS levels.

**v3.0** – Major API rewrite with GraphQL & gRPC support.