

Server (NATS Server or NATS Core)

- **Single executable** that manages message routing between clients.
- Self clustering, no zookeeper etc.
- Written in **Go** for simplicity, performance and scalability.
- Supports publish/subscribe, requests/reply and point-to-point (queueing) messaging patterns.

Client/Server architecture

- Applications use NATS client libraries to connect to the server.
- Can publish messages, subscribe to subjects, or both.
- Supports multiple programming languages, including Go, Java, Python and JavaScript.

Subject addressing

- Subjects are topic/channels for message exchange.
- Support hierarchical namespaces and wildcard subscriptions for flexible message routing.

Message

- Unit of data transmission. Everything is a message in NATS.
- Composed of:
 - **Subject:** The channel to which the message is published.
 - **Payload:** The binary content of the message.
 - **Headers:** Map with metadata.
 - **Reply-Subject:** Reply channel for RPC style communication

Queue Groups

- Used for **load balancing** among multiple subscribers.
- Each message is delivered to only one subscriber in the queue group.

JetStream (Persistence)

- Built-in persistence layer in NATS. Replicated and resilient.
- Adds advanced capabilities like:
 - Streaming: Store and replay messages.
 - Queues: Manages message delivery to multiple consumers.
 - **Delivery Guarantees:** Supports at least once and exactly-once delivery.
 - Flow Control: Decouples message production and consumption.
 - **Key/Value Store:** Provides a simple distributed key/value storage system.
 - **Per message Acks:** Ensures message processing and redelivery.

Consistent Replication

- Clustered NATS servers replicate messages for high availability.
- JetStream enables **persistent storage with fault tolerance.**

Wildcard Subscriptions

- **Single-level** (*): Matches one token in the subject hierarchy.
- Multi-level (>): Matches one or more tokens at the end of the subject hierarchy.
- Used for subscription, filtering, security, and transformation.

Key Features

- Lightweight: Minimal resource consumption, ideal for microservices and edge computing.
- Low Latency: Optimized for high performance low-latency messaging.
- **Persistence:** JetStream enables reliable message storage and delivery.
- **Scalability:** Supports horizontal scaling via clustering for high availability.
- Security: Offers TLS encryption, token-based authentication and subject based permissions.

Use Cases

- Microservices: Communication: Lightweight and fast inter-service messaging.
- **IoT and Edge Computing:** Low latency messaging for distributed Systems.
- Real-time Analytics: Stream processing and event-driven architectures.
- Event Streaming: Reliable message delivery with JetStream.
- Financial Services: High-Performance messaging for real-time trading systems.

A Brief History of NATS

- **2010:** Created by Derek Collison as a lightweight messaging system for Cloud Foundry.
- 2012: Open-sourced under the Apache 2.0 license.
- 2017: Founded Synadia to drive enterprise support, and a long-term roadmap. Synadia also manages the nats.io ecosystem, including the client libraries and NATS Connect.
- 2021: Introduction of NATS JetStream for message persistence and streaming.
- 2025 and Beyond: Continued adoption in edge computing, IoT, and microservices. Architectures, with ongoing enhancements to JetStream and clustering capabilities.
- Open-Source Community NATS is developed openly under the nats-io organization on GitHub, with contributions from companies like Siemens, VMware, and Cisco, as well as independent developers worldwide.
- Widespread Deployment: NATS is trusted by leading enterprises and platforms, including Mastercard, VMware, Cloud Foundry, Siemens, Schaeffler, Walmart, Alibaba and GE.

