

RESILIENCE  
REALIZED



KubeCon



CloudNativeCon

North America 2021

NATS



KubeCon



CloudNativeCon

North America 2021

RESILIENCE

REALIZED

# A New Generation of NATS

*Jean-Noël Moyne, Synadia Solutions & Engineering*

[jnm@synadia.com](mailto:jnm@synadia.com)

*Matthias Hanel, Synadia Engineering*

[mh@synadia.com](mailto:mh@synadia.com)

# What is NATS?



KubeCon



CloudNativeCon

North America 2021

NATS is a complete, production-proven, cloud-native messaging system

Made for developers and operators who want to spend more time doing their work and less time worrying about how to do messaging

- DNA: Performance, simplicity, security, and availability
- Runs and can be deployed anywhere from the cloud to the edge
- NATS 2: the best coverage messaging features



# NATS Community Ecosystem in numbers



KubeCon



CloudNativeCon

North America 2021

- Over 1,000 contributors, over 100 with more than 10 commits
- 30+ public repos
- 40+ client libraries
- 23,000+ GitHub stars across repos
- 10K GitHub stars just for nats-server (~1,000 Forks)
- ~150M NATS Server Docker Hub pulls
- ~3,500 Slack members

<https://github.com/nats-io>



# Complete messaging solution



KubeCon



CloudNativeCon

North America 2021

Subject-based pub/sub



# Complete messaging solution



KubeCon



CloudNativeCon

North America 2021

Many Client libraries

High Speed

High Fan-out

Subject-based pub/sub



# Complete messaging solution



KubeCon



CloudNativeCon

North America 2021

Request/Reply

Inboxes

Many Client libraries

High Speed

High Fan-out

Subject-based pub/sub



# Complete messaging solution



KubeCon



CloudNativeCon

North America 2021

Request/Reply

Queueing

Inboxes

Durable subscribers

Many Client libraries

High Speed

High Fan-out

Subject-based pub/sub





# Complete messaging solution



KubeCon



CloudNativeCon

North America 2021

Request/Reply

Multiple Replay policies

Queueing

Streaming

Inboxes

Durable subscribers

Exactly Once Delivery

Many Client libraries

High Speed

Persistence

High Fan-out

Subject-based pub/sub



# Complete messaging solution



KubeCon



CloudNativeCon

North America 2021

Request/Reply

Queueing

Inboxes

Durable subscribers

Multiple Replay policies

Streaming

Exactly Once Delivery

Persistence

RAFT

Many Client libraries

High Speed

High Fan-out

Subject-based pub/sub



# Complete messaging solution

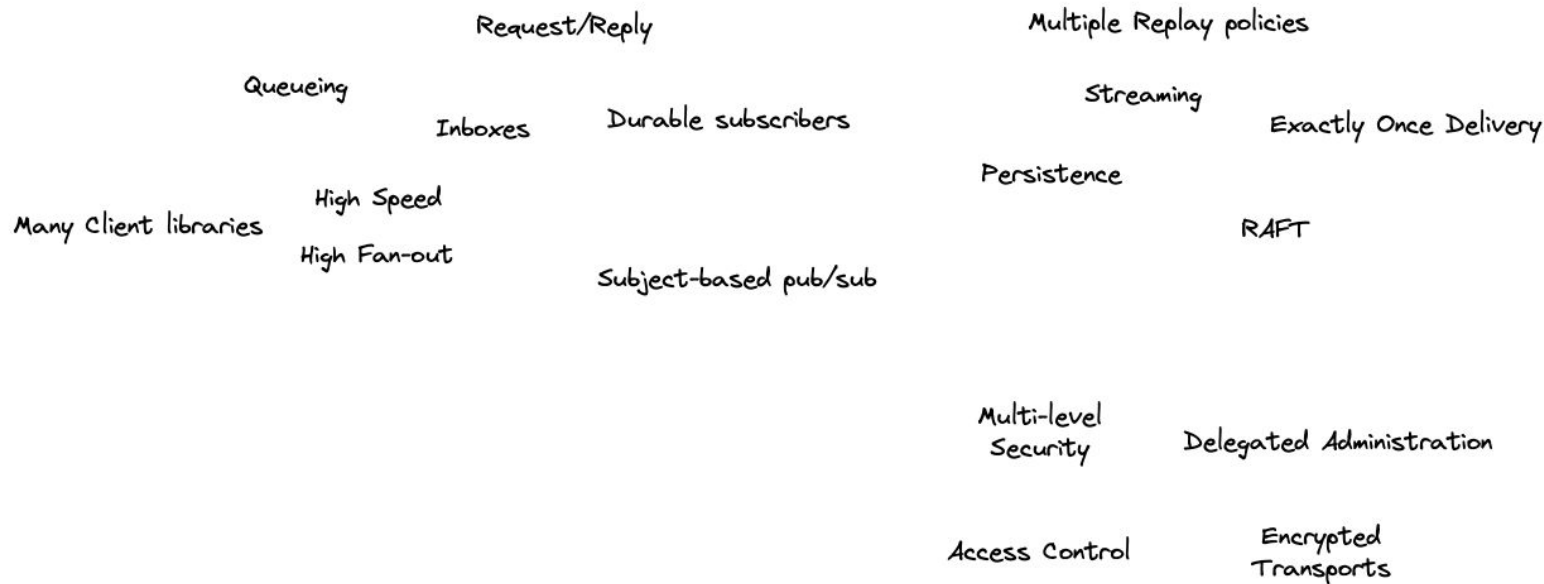


KubeCon



CloudNativeCon

North America 2021



# Complete messaging solution



KubeCon



CloudNativeCon

North America 2021

Request/Reply

Queueing

Inboxes

Durable subscribers

Multiple Replay policies

Streaming

Persistence

Exactly Once Delivery

RAFT

Many Client libraries

High Speed

High Fan-out

Subject-based pub/sub

Multi-level Security

Delegated Administration

Access Control

Encrypted Transports

Encryption at rest



# Complete messaging solution



KubeCon



CloudNativeCon

North America 2021

Request/Reply

Queueing

Inboxes

Durable subscribers

Multiple Replay policies

Streaming

Exactly Once Delivery

Persistence

RAFT

Subject mapping

Subject limits

Multi-level Security

Delegated Administration

Access Control

Encrypted Transports

Encryption at rest

Many Client libraries

High Speed

High Fan-out

Subject-based pub/sub



# Complete messaging solution



KubeCon



CloudNativeCon

North America 2021

Request/Reply

Queueing

Inboxes

Durable subscribers

Multiple Replay policies

Streaming

Exactly Once Delivery

Persistence

RAFT

Subject mapping

Subject limits

Multi-level Security

Delegated Administration

Access Control

Encrypted Transports

Encryption at rest

Many Client libraries

High Speed

High Fan-out

Subject-based pub/sub

Scalable Clustering



# Complete messaging solution



KubeCon



CloudNativeCon

North America 2021

Request/Reply

Queueing

Inboxes

Durable subscribers

Multiple Replay policies

Streaming

Exactly Once Delivery

Persistence

RAFT

Subject mapping

Subject limits

Many Client libraries

High Speed

High Fan-out

Subject-based pub/sub

Multi-cloud

Scalable Clustering

Multi-level Security

Delegated Administration

Service Geo-affinity

Multi-cluster Global Deployment

Access Control

Encrypted Transports

Edge

Hybrid

Encryption at rest



# Complete messaging solution



KubeCon



CloudNativeCon

North America 2021

Request/Reply

Queueing

Inboxes

Durable subscribers

Multiple Replay policies

Streaming

Persistence

Exactly Once Delivery

RAFT

Subject mapping

Subject limits

Multi-level Security

Delegated Administration

Access Control

Encrypted Transports

Encryption at rest

Many Client libraries

High Speed

High Fan-out

Subject-based pub/sub

Easy Configuration

Lightweight Servers

Embedable

OSS

Multi-cloud

Scalable Clustering

Service Geo-affinity

Multi-cluster Global Deployment

Edge

Hybrid





# Messaging functionality landscape

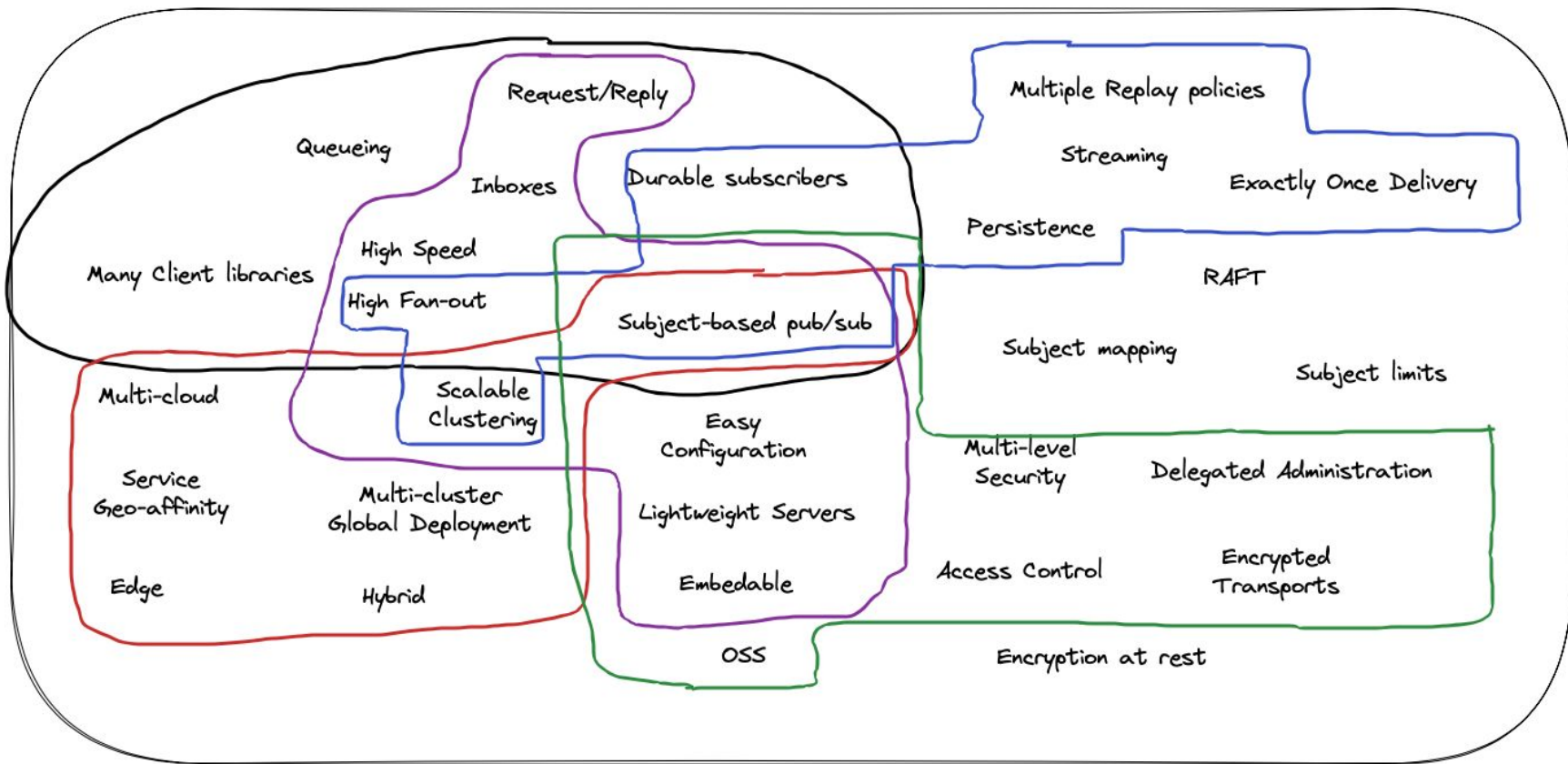


KubeCon



CloudNativeCon

North America 2021



# NATS 2 Timeline



KubeCon



CloudNativeCon

North America 2021

- Constant improvements as well as new features
- 2.0 (June 2019)
  - Security with Multi-tenancy
  - Global and multi-cloud deployments
- 2.2 (March 2021)
  - JetStream
  - Websocket and MQTT server support
  - `nats` CLI tool
  - Subject mapping
  - Message headers
  - Lambe duck mode
  - 'No responders'
- 2.3 & 2.4
  - Monitoring and management
  - Encryption at rest, OCSP Stapling
  - K/V Store
- 14 releases of nats-server in the last 12 months



# Security: Decentralized administration

- Hierarchical, delegated administration
- Signed JWTs describe operators, accounts and users
  - Operators create accounts
  - Accounts create users
  - Users present their credentials and permissions
- No need to configure the servers with account or user data
  - Servers only need to validate the trust chain of the JWT using the operator public key
  - Servers never need to know any private key
- Delegate administration of accounts and users by distributing the private keys



# Security: Multi-tenancy



KubeCon



CloudNativeCon

North America 2021

- Users are applications
  - Adapter instances, single-tenant instances of services and message streams
  - Only need to present their JWT
  - User JWTs are created by accounts (key holders) and hold the definition of which subjects the user can publish or subscribe to
- Accounts can be tenants, or business units
  - Isolated subject name space per account
  - Single tenant environments, Shared multi-tenant services, message streams, Control plane
  - Account JWTs are created by operators and define message routing between accounts



# JetStream: Next generation Streaming



KubeCon



CloudNativeCon

North America 2021

- Distributed persistence layer for NATS
- Streaming functionality
  - Replaces STAN (aka 'NATS Streaming')
  - Integration with core NATS
    - Provides a transition path of existing NATS application to streaming
- Distributed and consistent
  - Uses NATS optimized RAFT quorum algorithm
- FT and DR with replication
  - 1, 3, or 5 servers
  - Mirroring between streams
- File or Memory storage
- Decoupled Flow control
  - publisher to stream (server) and stream (server) to subscribers/consumers



# JetStream: Next generation Streaming

- Integrated with the security and multi-tenancy functionalities of NATS
  - Control the import/export of streams between accounts
- Streams can have multiple sources
  - Multiple subjects, wildcards, other streams
  - Subject filtering for consumers
- 3 retention policies available
  - limits, interest and working-queue
- Per stream and per subject message limits
- Many Replay policies
  - All, last, new, by starting sequence number, by start time
  - Last message per subject on a stream
  - Instant or original replay policy

*continued...*



# JetStream: Next generation Streaming

- Push and Pull (with batching) consumers
- Durable or ephemeral consumers
- Explicit or automatic acknowledgements
  - Ack/Nack/InProgress
- Explicit or 'All' acknowledgements
- Exactly once delivery
  - Combines Message Deduplication and double acks
- Mirroring
- Observable
- Encryption at rest
- Simple administration and low configuration!
- Speed!



# JetStream: More than just Streaming



KubeCon



CloudNativeCon

North America 2021

- KV Store
  - Consistent put, get, delete
  - Watch to subscribe to changes
  - In-line coherent cache
  - History per key
- More to come...





# Subject Mapping

- Simple mapping: “foo” -> “bar”
  - “service.foo” -> “service.foo.v1”
- Subject token re-ordering: “bar.\*.\*” -> “baz.\$2.\$1”
- Weighted mappings for traffic shaping
  - E.g. “service.foo” -> 90% to “service.foo.v1” / 10% to “service.foo.v2”
  - A/B testing, canary releases
  - Introduce artificial message ‘loss’
- You can ‘reload’ the server to make changes with zero downtime
- Mappings can be global or per account
- Mappings can also happen between accounts



CLI tool for interacting, monitoring and administering NATS and streams

- Publish, subscribe, request and reply
- View server, connection, stream and consumer information, system events and reports
- View a lot of information about the servers/connections/accounts/latencies/etc...
- On the fly administration and monitoring of streams and consumers
  - Create/delete streams and consumers
  - View information and reports on streams
  - View, monitor and remove messages in streams
  - Backup and restore streams
  - Interact with the stream's RAFT cluster
- K/V operations
- Benchmarks (pub/sub, request/reply, stream sync/async publishers and consumers)
- Built-in cheats: e.g. `nats cheat bench`



# NATS Architectures: Single server



KubeCon



CloudNativeCon

North America 2021



# Deployment Architectures: Adaptive Edge



KubeCon



CloudNativeCon

North America 2021

- Multiple data centers
- Multiple regions
- Multiple clouds
- On-prem
- On the Edge
  - Partially connected

... or any combination thereof

- Disaster recovery with geo-affinity for services



# NATS Architectures: Cluster

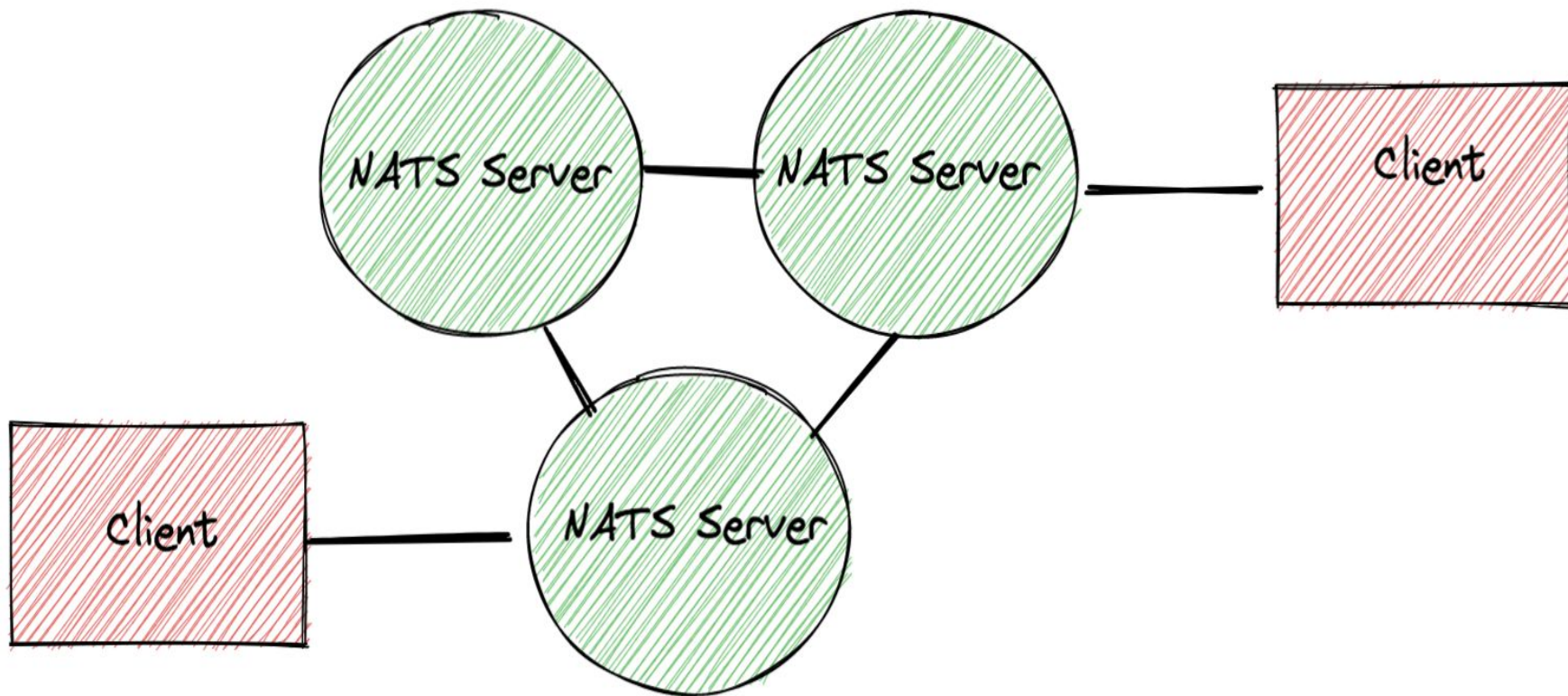


KubeCon

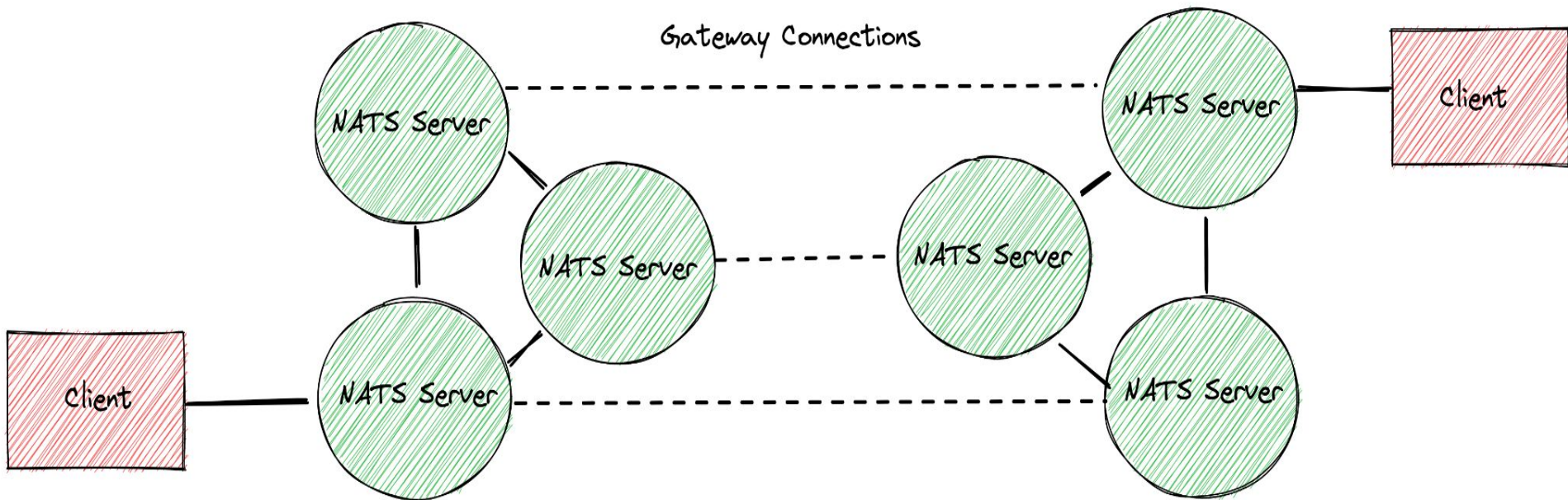


CloudNativeCon

North America 2021



# NATS Architectures: Supercluster





# NATS Architectures: Leaf Nodes



KubeCon



CloudNativeCon

North America 2021

