What if your message broker can also manage your workloads ?

About me

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Previous

- Co-founder energy efficiency / IoT startups
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- Docker / Kubernetes trainer

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EXOSCALE

European Cloud Provider

- Compute
- Kubernetes
- Object Storage
- Block Storage
- GPU Servers
- Networking
- Virtual Private Cloud
- DBaaS
- CDN
- DNS

FRANKFURT	DE-FRA-1
VIENNA	AT-VIE-1
VIENNA-2	AT-VIE-2
GENEVA	CH-GVA-2
ZURICH	CH-DK-2
SOFIA	BG-SOF-1
MUNICH	DE-MUC-1
ZAGREB	HR-ZAG-1

Disclaimer : why a talk about NATS ?

- I’m not working at Synadia
- I’m not a NATS contributor

… but…

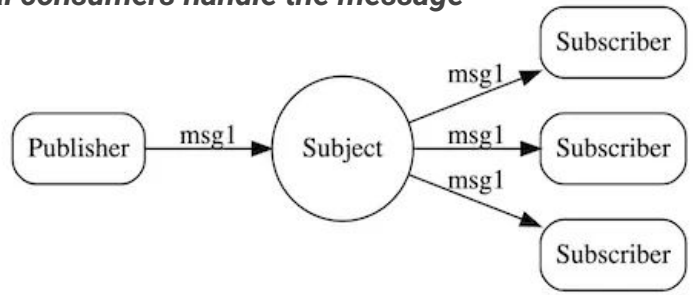
- I’m a user who likes this piece of technology
- I use it in various projects (pro and personal)
- I like to explore new ways to manage workloads (promise of **Nex**)
- It’s very cool :)

NATS : a quick history

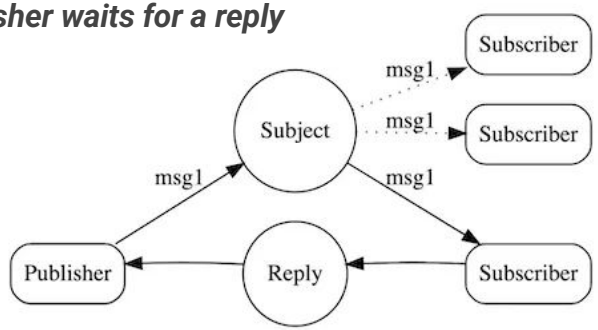
- Message broker (Publish / Subscribe, …)
- Created in **2011**
- Donated to the CNCF in **2018** (currently in **Incubating**)
- Used by many companies
- Evolution of the feature set
  - communication layer (message broker)
  - storage layer (data stream / Jetstream)
  - **workload layer (execution engine / Nex) ⇒ Experimental**

Message Broker

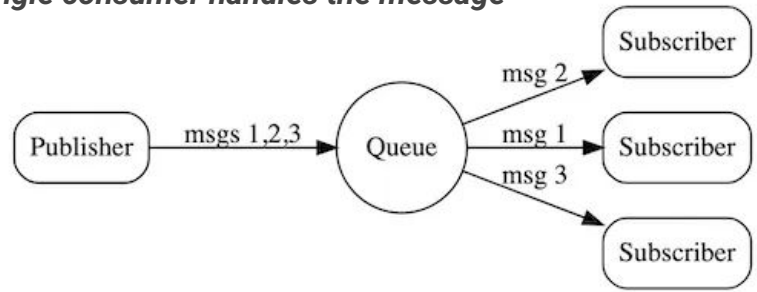
Several consumers handle the message



Publisher waits for a reply



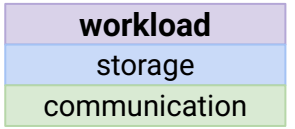
A single consumer handles the message



workload
storage
communication

JetStream Persistent Engine

- Built into NATS Server
- Store and replay messages
  - great in environment with connectivity issues
- Storage solutions built on top
  - Key Value store
  - Object store

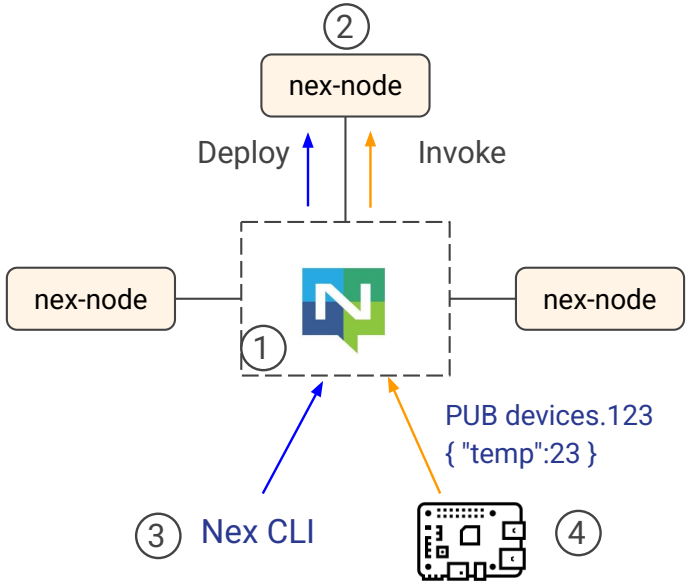


NATS Execution Engine (Nex)

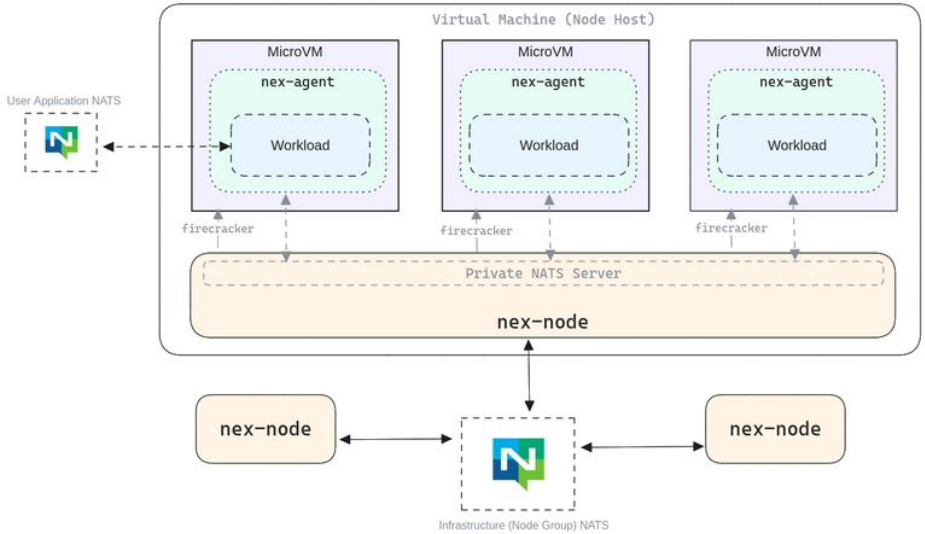
- Deploy and run workloads with NATS
- Services
  - long-running processes
- Functions
  - event-triggered, short-lived workloads

Getting started with Nex

1. Run NATS with JetStream enabled
2. Run Nex nodes connecting to NATS
3. Deploy a function using Nex CLI
4. Invoke the function



Nex : architecture overview



nex-node

- run your workloads in isolated environments
- exposes a control api over NATS

nex-agent

- manages one workload
- bridge between NATS and the workload
- receives messages / runs workload / sends results back

Source: https://docs.nats.io/

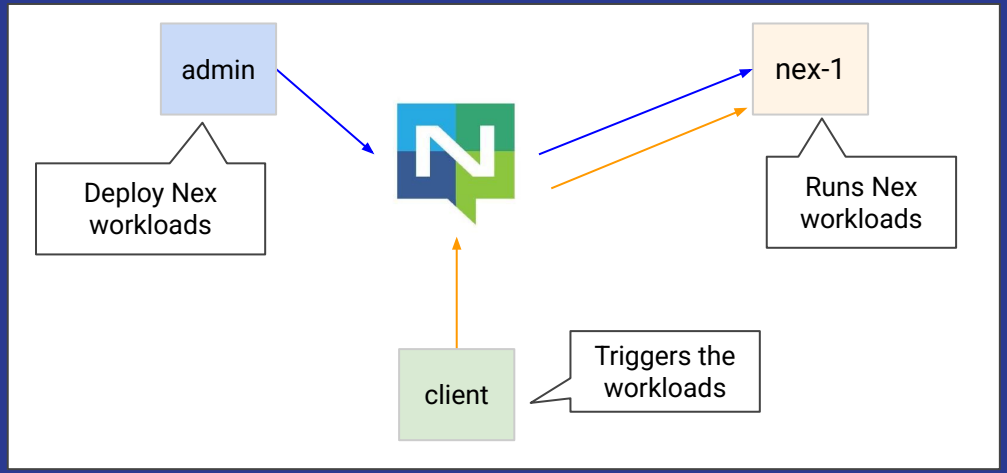
Nex : service

- Long running process (web servers, api, …)
- In **sandbox** mode
  - a service runs in a Firecracker microVM
  - statically-linked linux binaries
- In **no sandbox** mode, a service runs on the host
  - Linux / macOS / Windows

Nex : function

- Short lived process similar to AWS Lambda
- Triggered by a message on a specific NATS subject
- In **sandbox** mode, a function runs in a Firecracker microVM
- In **no sandbox** mode, a function runs on the host
- Implemented in JavaScript or compiled in WebAssembly
- Javascript functions have access to host's services (messaging, KV store, Object store)

Demo


admin
Deploy Nex workloads
nex-1
Runs Nex workloads
client
Triggers the workloads

Deploying a Javascript function

```
(subject, payload) => {
  console.log(subject);
  return {
    triggered_on: subject,
    payload: String.fromCharCode(...payload)
  }
};
```

echo.js

Deploys the function and links it to the “echo” subject

$ nex devrun ./echo.js --trigger_subject=echo --type v8

$ nats req echo ‘hello nex!’

{"triggered_on":"echo","payload":"hello nex!"}

Invokes the function sending a message on “echo” subject

Deploying a WASM function

```rust
use std::{env, io::{self, Read, Write}};
fn main() {
    let args: Vec<String> = env::args().collect();
    let mut buf = Vec::new();
    io::stdin().read_to_end(&mut buf).unwrap();
    let mut subject = args[1].as_bytes().to_vec();
    buf.append(&mut subject);
    io::stdout().write_all(&mut buf).unwrap();
}
```

main.rs

```toml
[package]
name = "echo"
version = "0.1.0"
edition = "2021"

[[bin]]
name = "echo"
path = "src/main.rs"
```

Cargo.toml

$ cargo build --target wasm32-wasi --release

Builds the function for webassembly

$ nex devrun echo.wasm –trigger_subject=echowasm –type wasm

Deploys the function on a Nex node

$ nats req echowasm ‘hello nex!’
Hello nex!...

Invokes the function

Host Services

Javascript functions can access host services

- NATS communication layer
- KV Store
- Object Store
- HTTP Client

Note: error handling was removed for readability

Access to host Services (1/2)

```
(subject, payload) => {
  let data = JSON.parse(String.fromCharCode(...payload));
  const deviceId = data.deviceId || "unknown";
  const temp = data.temperature;

  this.kv("iot_devices").set(deviceId, payload);
  this.objectStore("iot_history").put(deviceId + "-" + Date.now() + ".json", payload);

  let httpAlert = null;
  if (typeof temp === "number" && temp > 30) {
      const body = JSON.stringify({ deviceId, temperature: temp, ts: Date.now(), subject });
      const bytes = new Uint8Array(body.length);
      for (let i = 0; i < body.length; i++) bytes[i] = body.charCodeAt(i) & 0xff;
      const resp = this.http.post("https://webhooks.app/data", bytes);
      httpAlert = { status: resp?.status, length: resp?.response?.length };
  }
  return {
      ok: true, subject,device: deviceId,temperature: temp,kv_bucket: "iot_devices",
      object_bucket: "iot_history", http_alert: httpAlert};
};
```

KV: store the incoming payload

Append history item in Object Store

Send HTTP alert if temp > 30

telemetry.js

Note: error handling was removed for readability

Access to host Services (2/2)

```
(subject, payload) => {
  // Get jokes from KV store
  const jokesData = this.kv("dad_jokes").get("jokes");
  const jokes = JSON.parse(String.fromCharCode(...jokesData));

  // Pick a random joke
  const randomIndex = Math.floor(Math.random() * jokes.length);
  const joke = jokes[randomIndex];

  // Return the joke
  return {
    joke: joke.setup,
    punchline: joke.punchline
  };
};
```

Get content from KV store

jokes.js

Deploying a service

```
package main

import (
	"context"
	"os"
	"github.com/nats-io/nats.go"
	services "github.com/nats-io/nats.go/micro"
)

func main() {
	ctx := context.Background()
	natsUrl := os.Getenv("NATS_URL")
	if natsUrl == "" { natsUrl = "nats://192.168.127.1:4222" }

	nc, err := nats.Connect(natsUrl)
	if err != nil { panic(err) }

	echoHandler := func(req services.Request) { req.Respond(req.Data()) }

	_, err = services.AddService(nc, services.Config{
		Name:    "EchoService",
		Version: "1.0.0",
		Endpoint: &services.EndpointConfig{
			Subject: "svc.echo",
			Handler: services.HandlerFunc(echoHandler),
		},
	})
	if err != nil { panic(err) }
	<-ctx.Done()
```

echo.go

URL to connect to NATS from within the Firecracker VM

Static compilation

$ CGO_ENABLED=0 go build -tags netgo -ldflags '-extldflags "-static"' -o echo

$ nex devrun ./echo

Deploying the service

$ nats req svc.echo 'can you repeat?'

Invoking the service

Echoes the payload received on **svc.echo**

Nex status

- Current Status
  - open source: experimental, APIs may change
  - commercial: available as Workloads in Synadia cloud (containers + JS functions)
- Current Limitations of OSS
  - manual node management
  - limited JavaScript runtime (v8go constraints)
  - not easy to debug workloads
- Coming next
  - OCI image support to run workloads from container images

When might Nex be worth exploring?

- Worth exploring if you are
  - comfortable with experimental technology
  - already using NATS
  - building event-driven or IoT applications
  - looking for Lambdas triggered by NATS messages instead of HTTP
- Probably not the right fit if you have
  - monolithic applications
  - simple CRUD over HTTP
  - no streaming requirements

Takeaways

- NATS is evolving: communication → storage → execution
- Nex runs services (long-running processes) and functions (event driven)
- Experimental but promising
- Easy to try

Want to try Nex ?

- NATS Documentation : https://docs.nats.io/using-nats/nex
- NATS Slack Channel: https://slack.nats.io
- Nex GitHub repository : https://github.com/synadia-io/nex

Questions ?

Thank you !

https://luc.run/cd25.pdf