



.NET Microservices with Dapr

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About me:

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Our Products:

Multi-Tenant OpenID Connect Identity Provider



www.proauth.net

Enterprise Application Framework for .NET



www.reafx.net

Slide Download



<https://www.4tecture.ch/events/techorama2024>

Agenda

- Intro
- Dapr Basics
 - BB: Service Invocation
 - BB: Pub/Sub
 - BB: State Management
 - BB: Virtual Actors
 - BB: Secret Management
 - BB: Observability
 - BB: Resiliency
- Conclusion





Dapr

Intro

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CLOUD NATIVE

YOU KEEP USING THAT WORD, I DO
NOT THINK IT MEANS WHAT YOU THINK IT MEANS

Cloud computing characteristics by NIST

- On-demand self-service
- Broad network access
- Resource pooling
- Rapid elasticity
- Measured service

CNCF cloud native definition

Cloud native technologies empower organizations to build and run scalable applications in modern, dynamic environments such as public, private, and hybrid clouds. Containers, service meshes, microservices, immutable infrastructure, and declarative APIs exemplify this approach.

These techniques enable loosely coupled systems that are resilient, manageable, and observable. Combined with robust automation, they allow engineers to make high-impact changes frequently and predictably with minimal toil.

The Cloud Native Computing Foundation seeks to drive adoption of this paradigm by fostering and sustaining an ecosystem of open source, vendor-neutral projects. We democratize state-of-the-art patterns to make these innovations accessible for everyone.

Cloud native applications

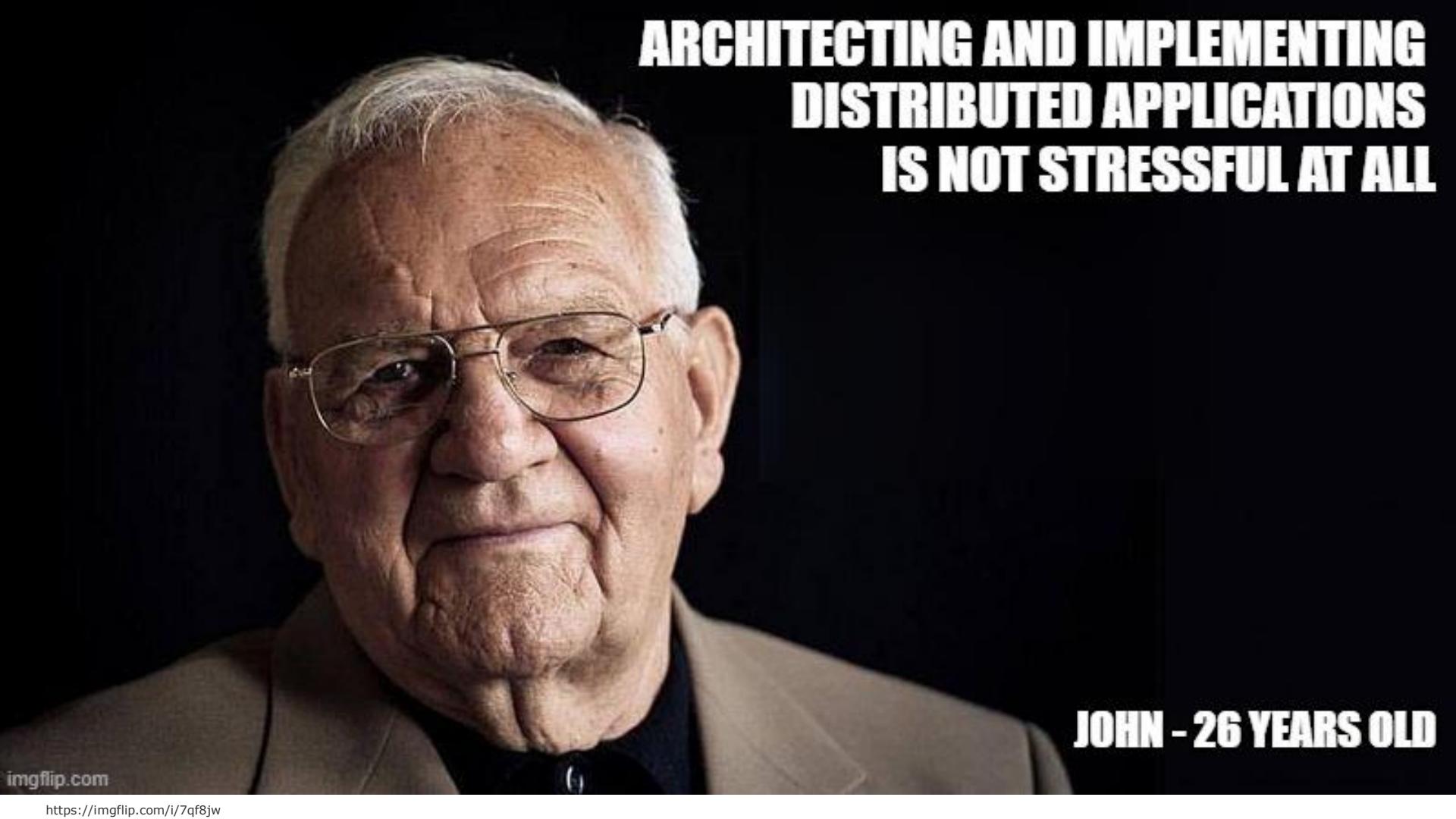
Cloud-native applications should be designed and implemented to use and take advantage of the cloud computing characteristics.

Cloud native applications characteristics

- Immutable Packaging & Execution
- Decoupled Configurations and Secrets
- Stateless and Statefulness
- Modular Applications / Microservices
- Polyglot Paradigm (multi lang / tech)
- Centralized Logging and Monitoring
- DevOps and SRE processes
- Automation
- API-Centric

Commonly used with cloud native apps

- Microservices
- Cloud platforms
- Containers
- Kubernetes
- immutable infrastructures
- declarative APIs
- Continuous Delivery technologies



**ARCHITECTING AND IMPLEMENTING
DISTRIBUTED APPLICATIONS
IS NOT STRESSFUL AT ALL**

JOHN - 26 YEARS OLD

Challenges with Distributed Apps

- Lots of components / services
- Service-to-service communication
- Decoupling by using events
- Handling state across multiple instances
- Stateful services / actors
- Local dev environment vs. cloud environment



Portable, event-driven runtime



Build connected distributed applications faster

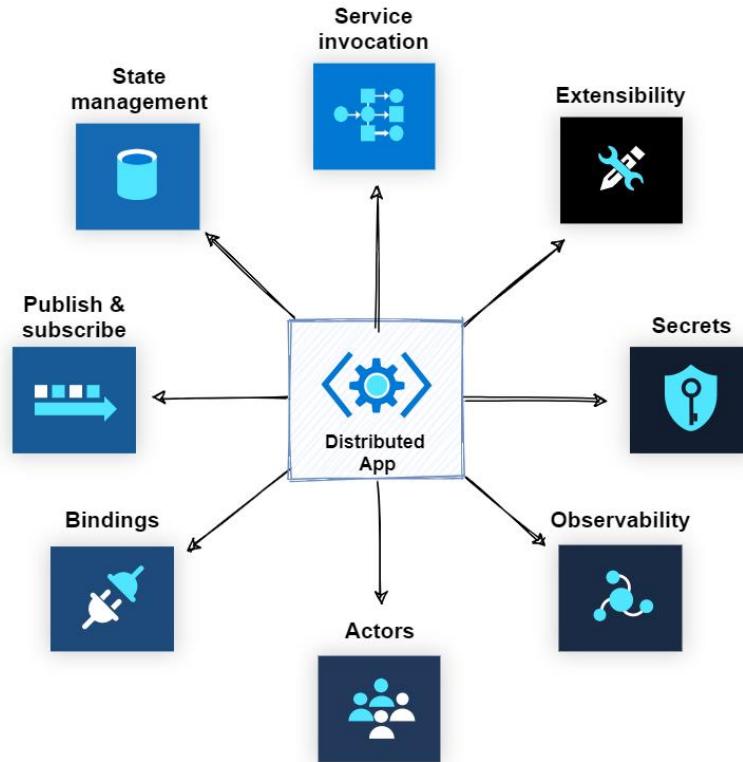


APIs for solving distributed application challenges

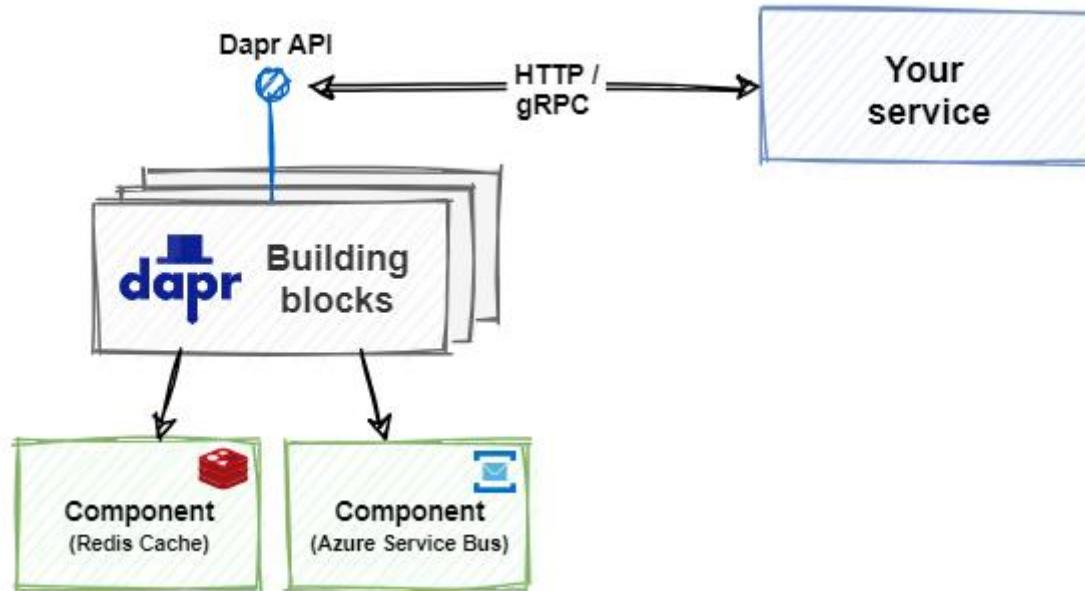


Cloud and Edge

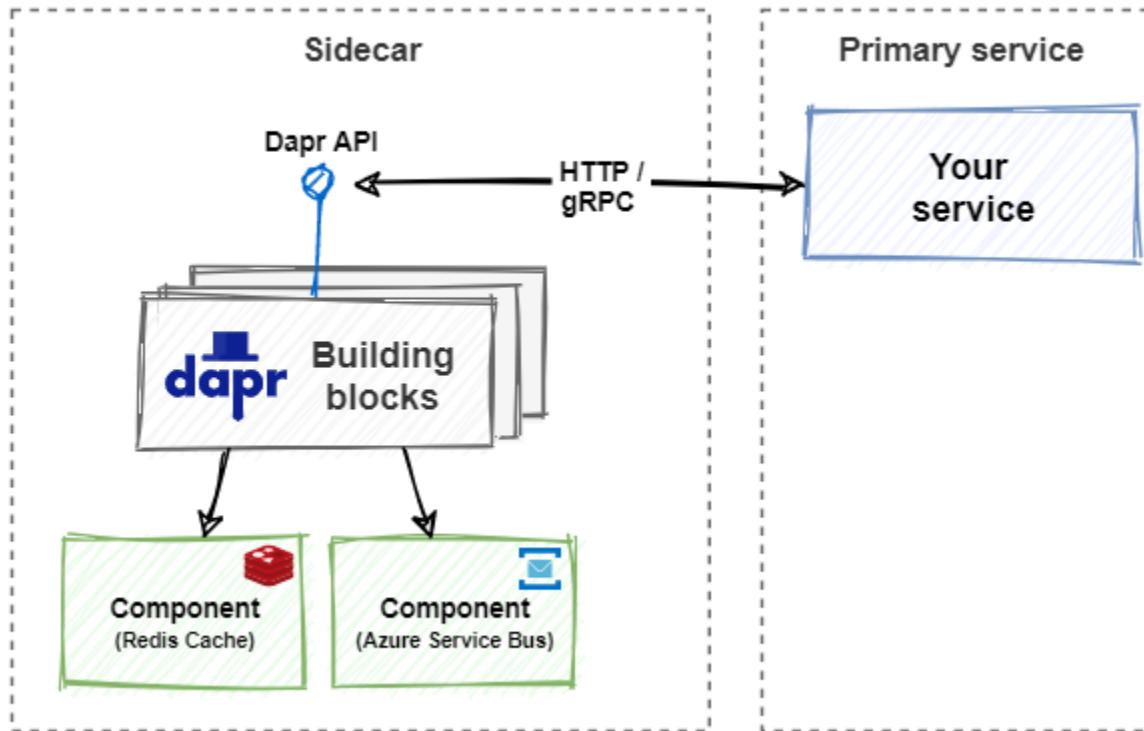
Dapr Building Blocks



Dapr Building Blocks Abstraction



Dapr Sidecar Architecture





Dapr Basics

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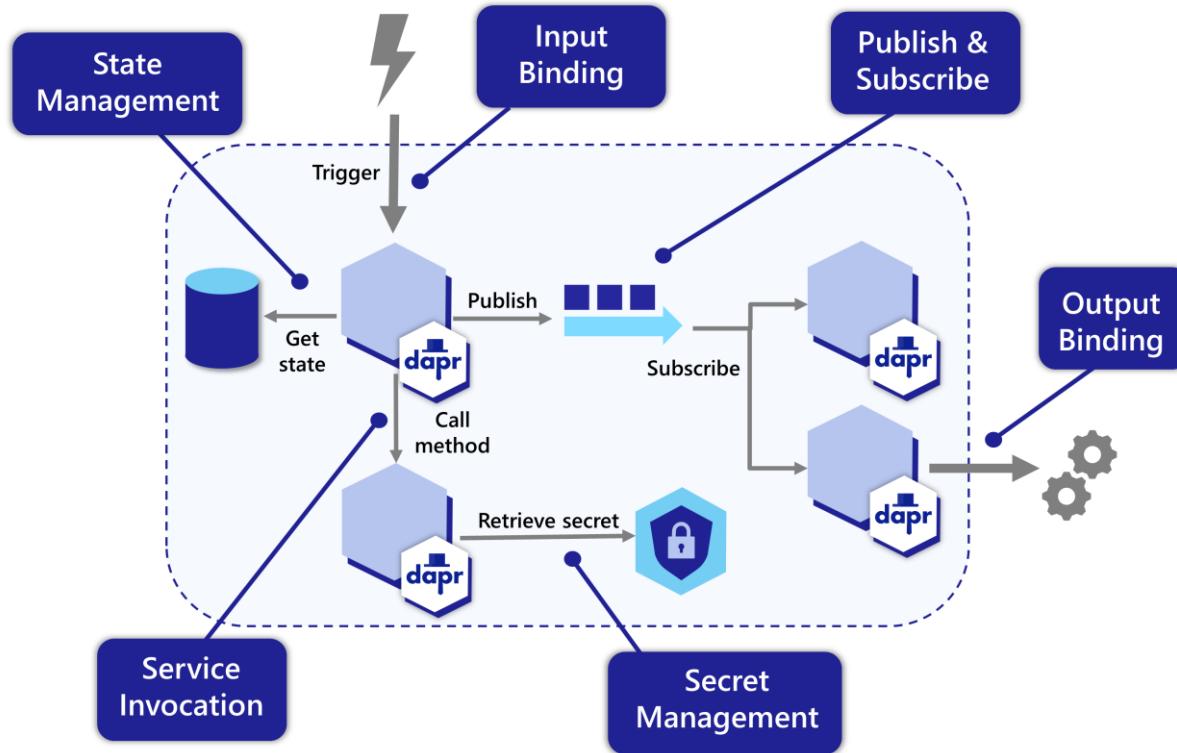
Dapr

- dapr.io
- Open source
- Originated at Microsoft
- Cloud Native Computing Foundation (CNCF)

Dapr – High Level Definition

- Any language or framework
- Portable APIs
- **Building blocks applying best practices**
 - Use the blocks you need
 - No big bang framework
- Platform agnostic
- Extensible and pluggable components

Dapr Building Blocks Overview



Single API - Multiple Components

```
var weatherForecast = await  
daprClient.GetStateAsync<WeatherF  
orecast>("statestore", "AMS");  
  
daprClient.SaveStateAsync("statesto  
re", "AMS", weatherForecast);
```

- AWS DynamoDB
- Aerospike
- Azure Blob Storage
- Azure CosmosDB
- Azure Table Storage
- Cassandra
- Cloud Firestore (Datastore mode)
- CloudState
- Couchbase
- Etcd
- HashiCorp Consul
- Hazelcast
- Memcached
- MongoDB
- PostgreSQL
- Redis
- RethinkDB
- SQL Server
- Zookeeper

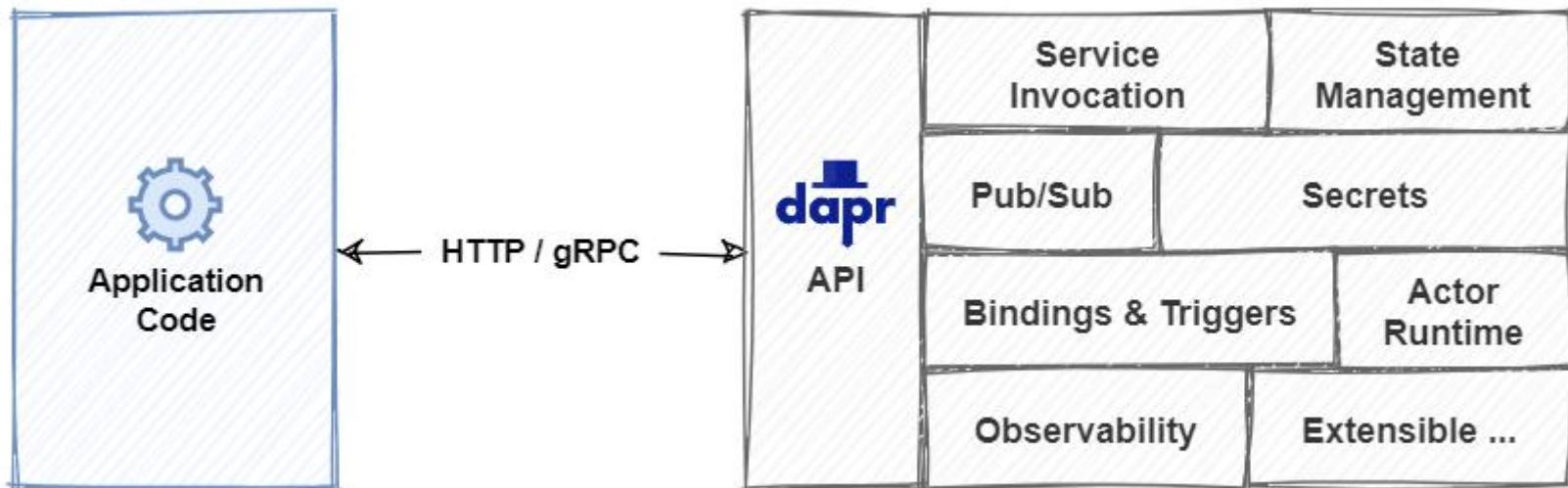




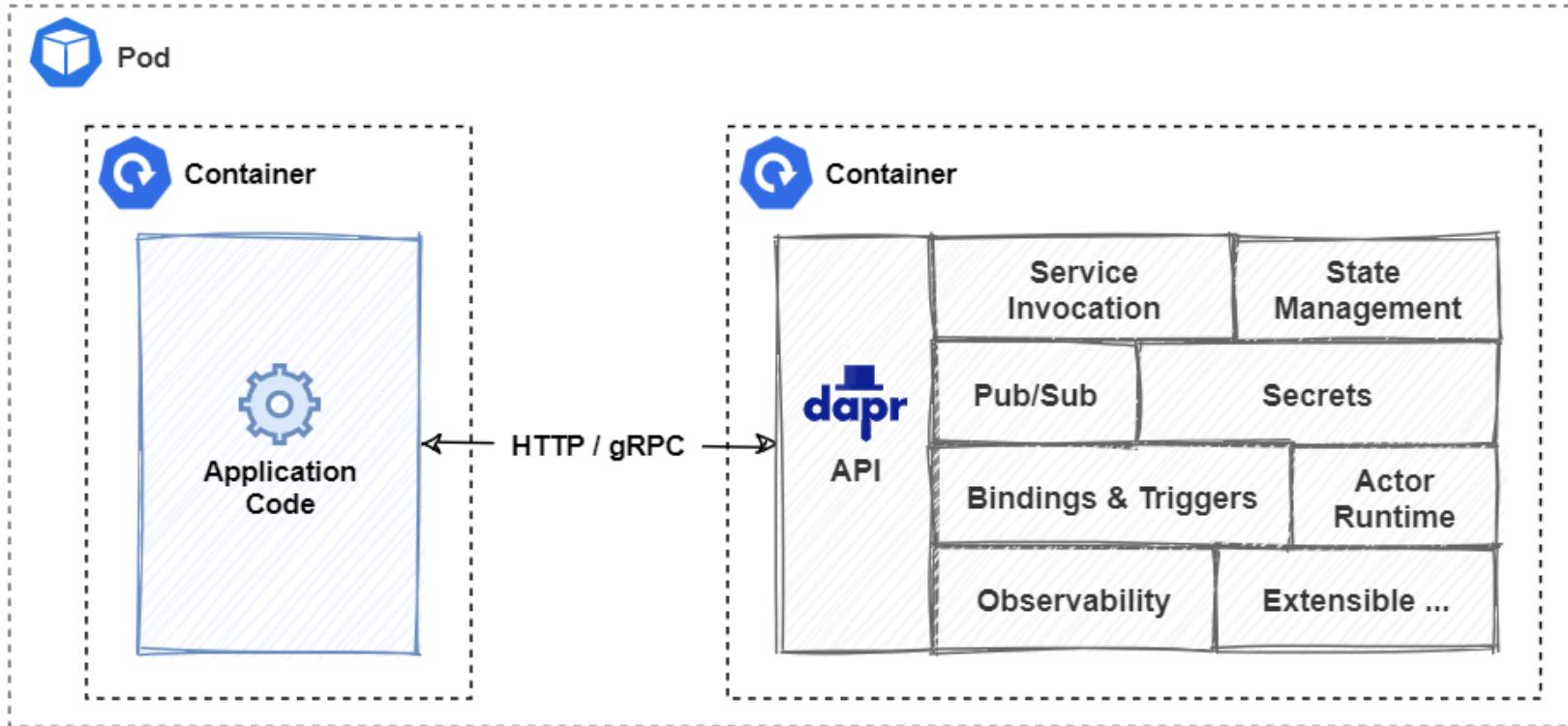
The Dapr sidecar provides built-in
security, resiliency and observability
capabilities.

Speeds up application development by providing an integrated set of APIs for communication, state, and workflow.

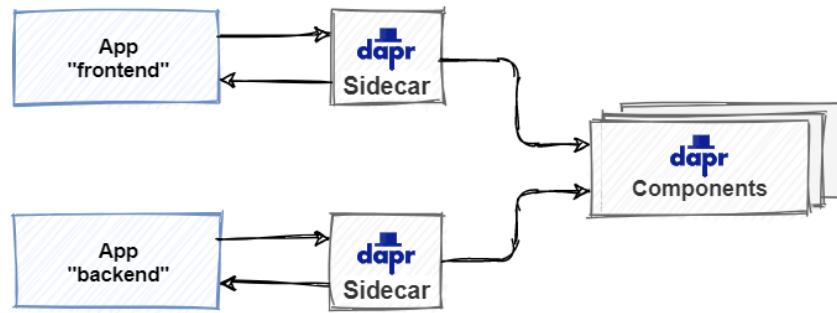
Self-hosted Sidecar



Kubernetes-hosted Sidecar



Sidecar Performance Considerations



- Dapr operation:
>= 1 out-of-process network call
- Heavily optimized sidecar implementation
- gRPC with multiplexing, bidirectional full-duplex, streaming
- Overhead should be sub-millisecond

SDK Overview

Language	Status	Client	Server extensions	Actor	Workflow
.NET	Stable	✓	ASP.NET Core	✓	✓
Python	Stable	✓	gRPC FastAPI Flask	✓	✓
Java	Stable	✓	Spring Boot Quarkus	✓	✓
Go	Stable	✓	✓	✓	✓
PHP	Stable	✓	✓	✓	
Javascript	Stable	✓		✓	✓
C++	In development	✓			
Rust	In development	✓		✓	

Runtimes



Self-Hosted

- Dedicated process next to your application process
- Executable or Docker Image

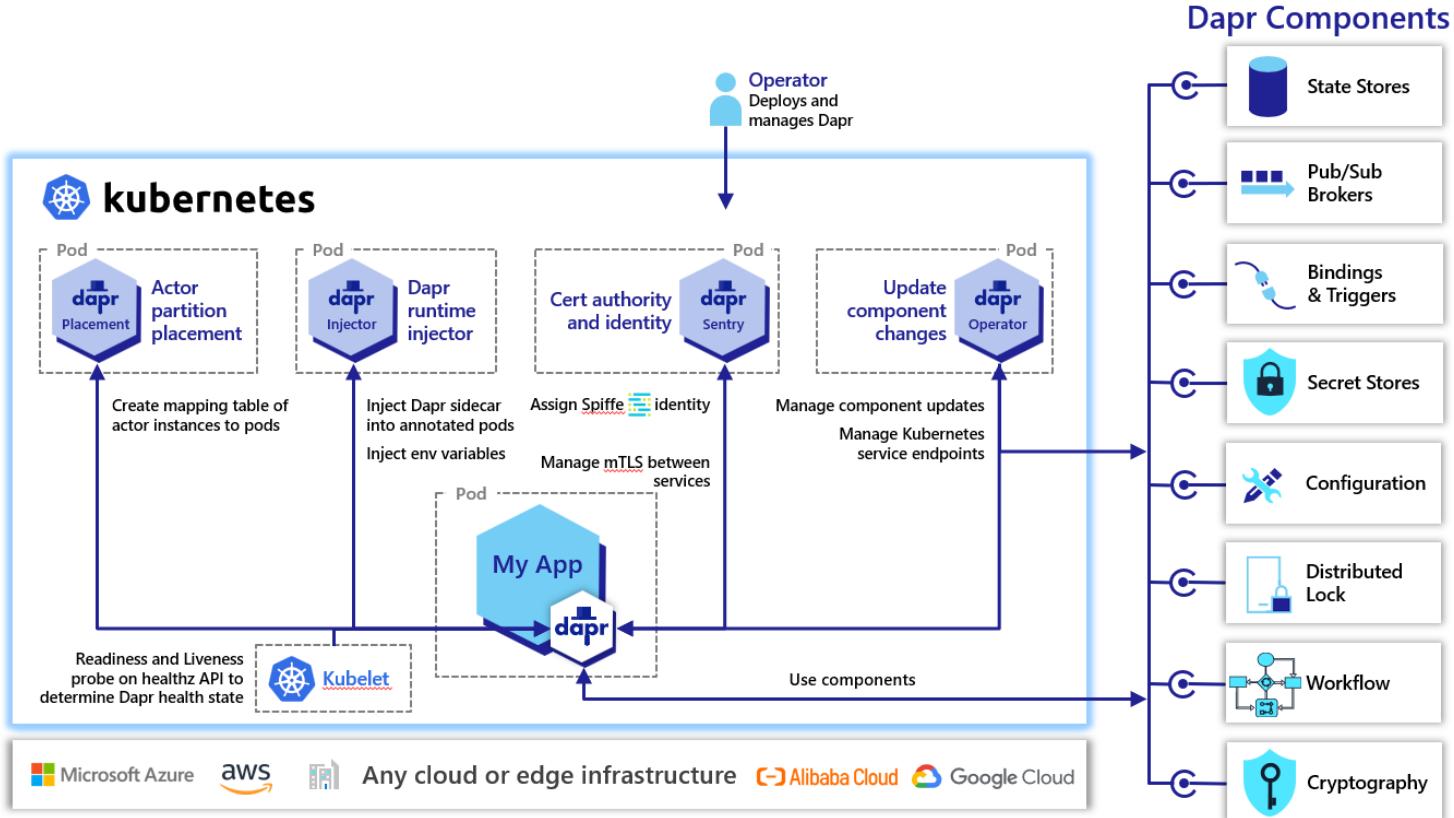
Kubernetes

- Sidecar container in your pod, uses localhost interface
- Usually injected based on attributes

Serverless

- Integrated in Azure
- i.e. Container Apps

Dapr in Kubernetes



Dapr from development to hosting

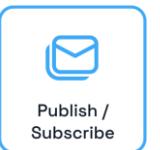
Use any language or runtime



HTTP/gRPC



Workflow



Publish /
Subscribe



Service
Invocation



State
Management



Actors



Observability



Security



External
Configuration



Secrets



Bindings



Cryptography



Distributed
lock



Middleware



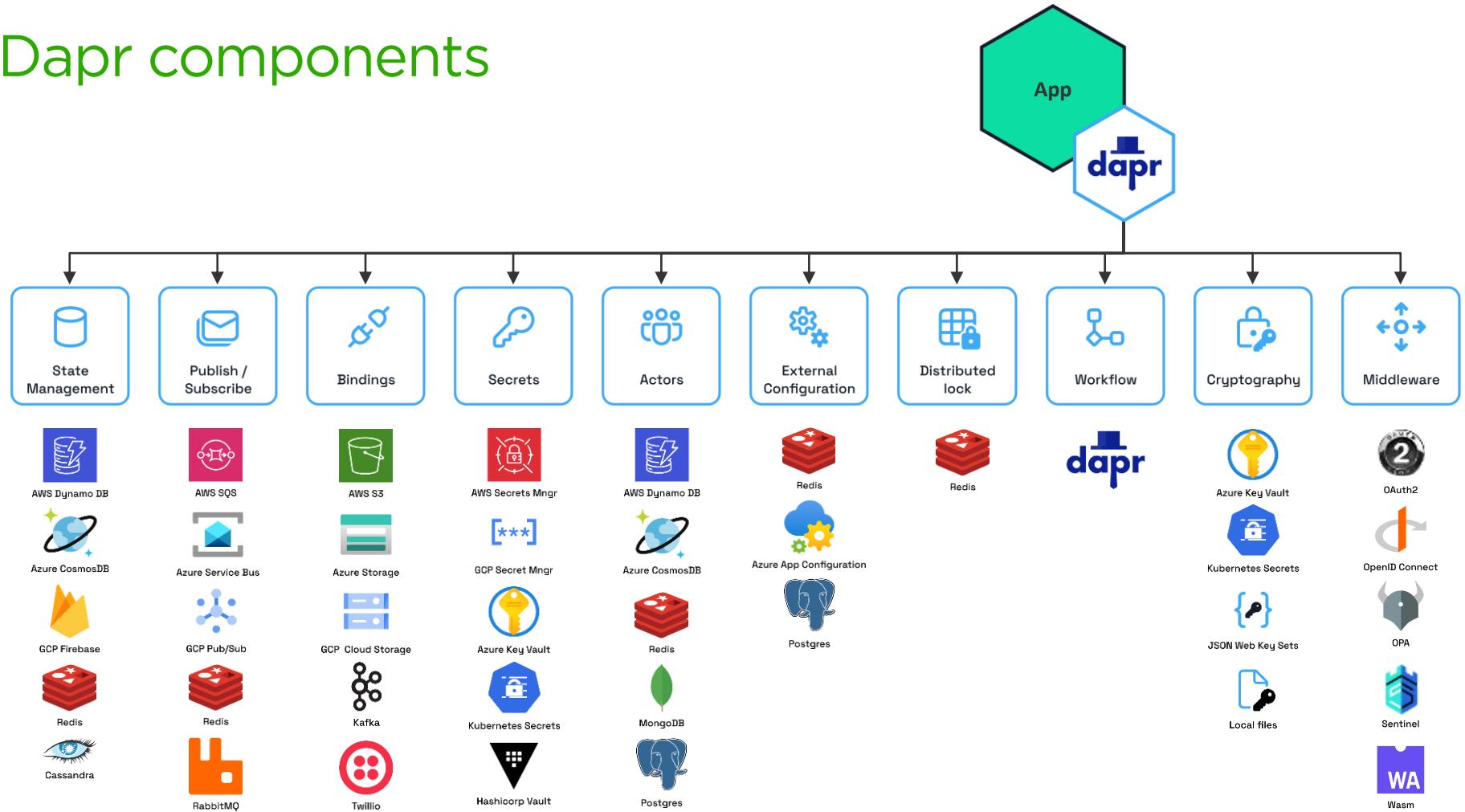
Resiliency

Host on any cloud or edge infrastructure



Virtual or
physical machines

Dapr components

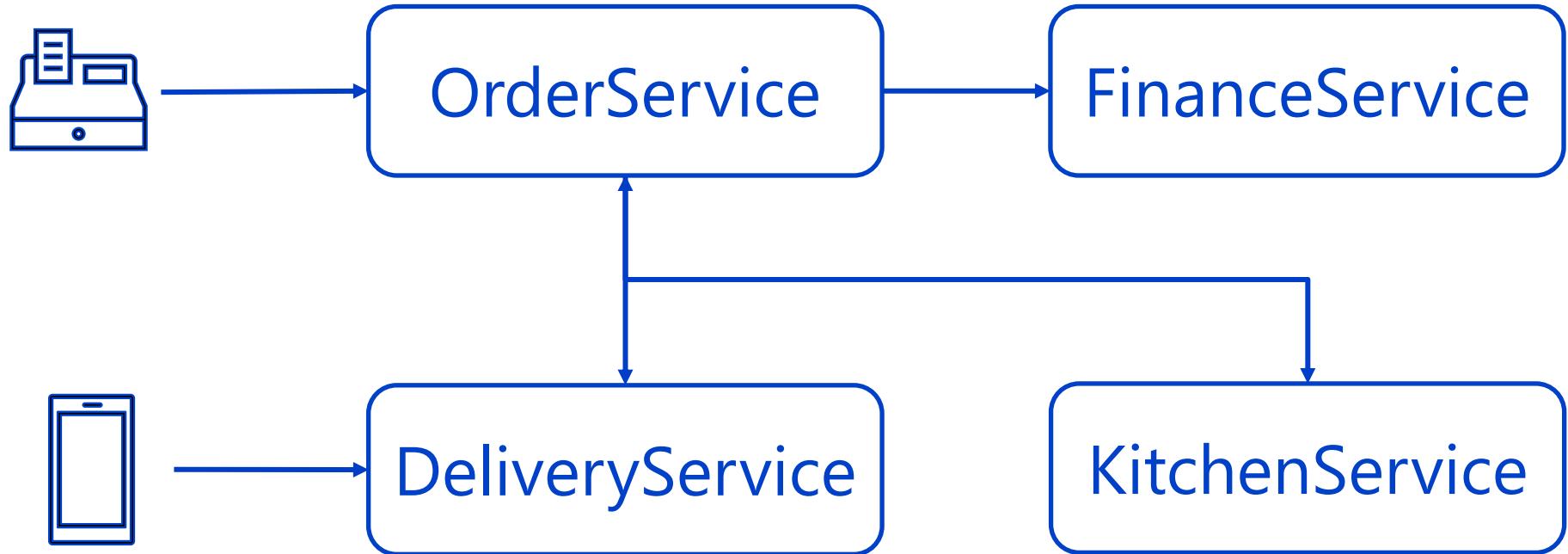




Demo first

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Fast Food Company



DEMO



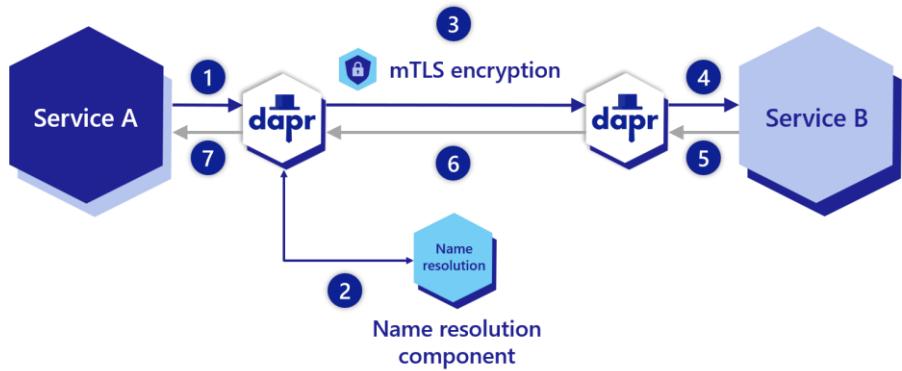
A close-up, low-angle shot of several rowers in a racing shell. Their legs and torsos are visible as they pull on their oars. The water is choppy, creating white spray at the bow. The rowers are wearing blue and red athletic gear.

Dapr Building Blocks

Service Invocation and Configuration

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Service Invocation

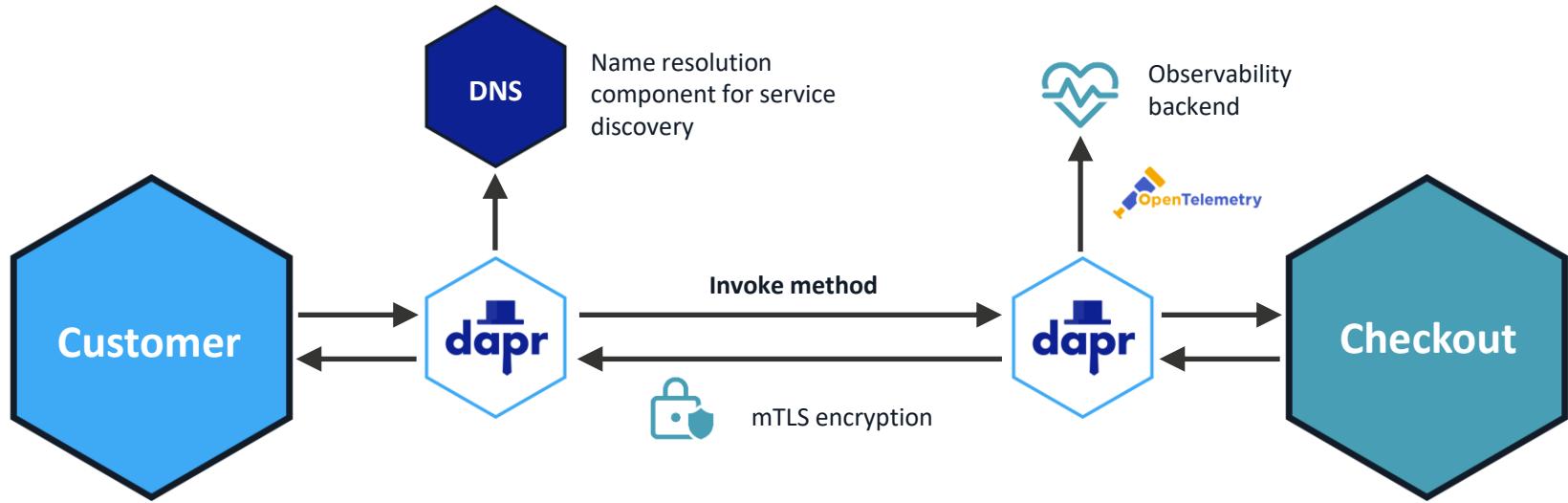


- HTTP and gRPC
- mTLS (with Dapr Sentry)
- Resiliency including retries
- Tracing and metrics with observability
- Access control (policies)
- Namespace scoping
- Load balancing (round robin with mDNS)
- Pluggable service discovery

Service Invocation



Service
Invocation



POST
[http://localhost:3500/v1.0/invite/checkout/method/order](http://localhost:3500/v1.0/invoke/checkout/method/order)

POST
<http://localhost:5100/order>

DEMO



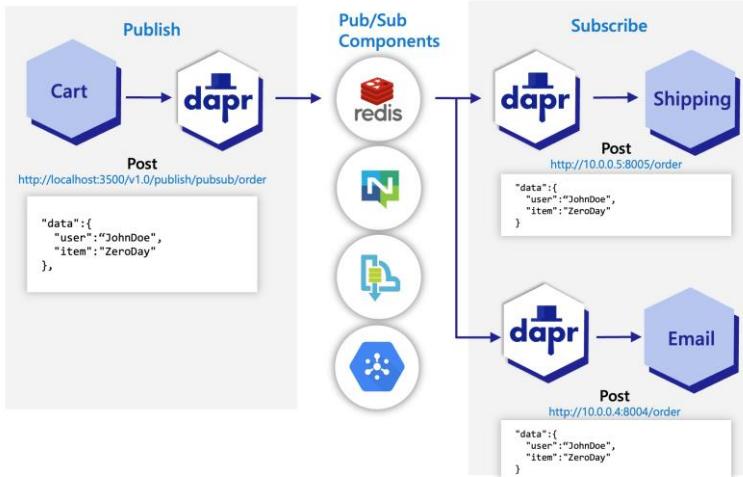
A close-up, low-angle shot of several rowers in a racing shell. They are wearing blue and red athletic gear. Their oars are extended, dipping into the water. The background is blurred, suggesting motion on a body of water.

Dapr Building Blocks

Publish & Subscribe

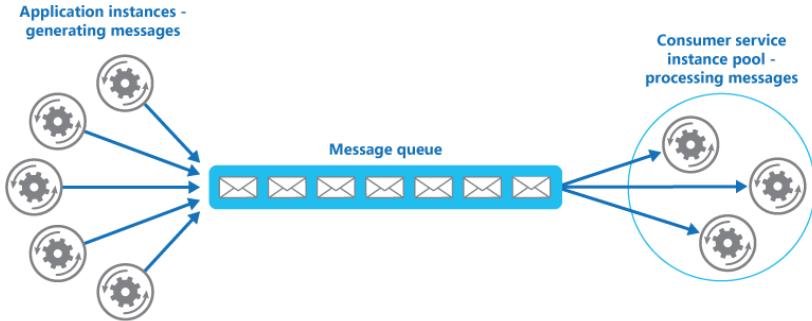
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Publish & Subscribe



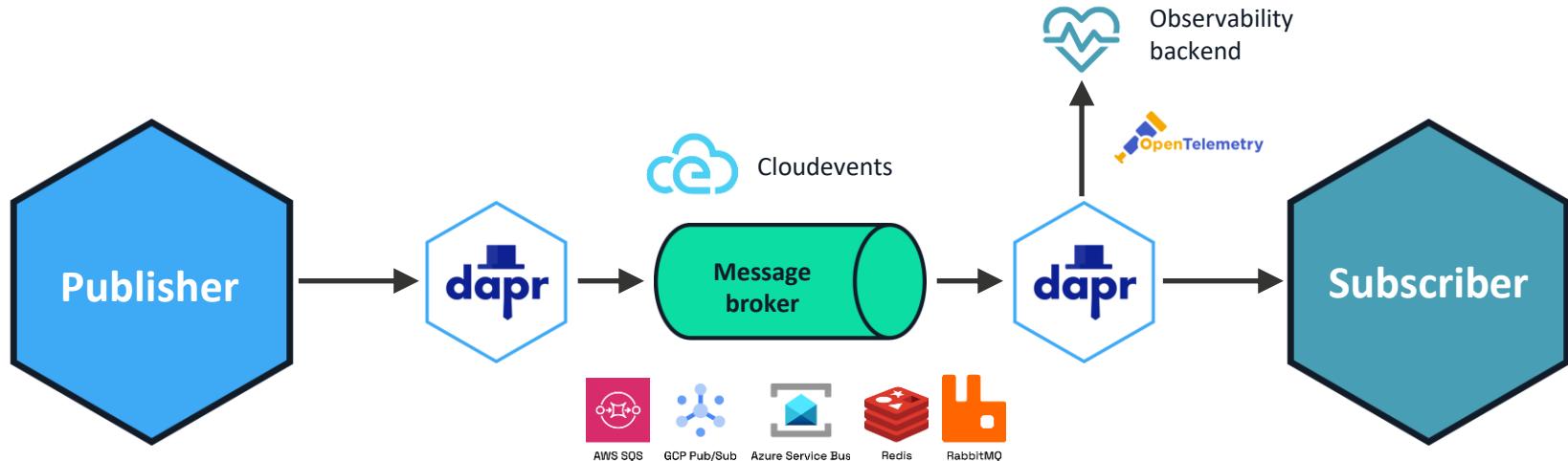
- Platform-agnostic API to send and receive messages
- At-least-once message delivery guarantee
- Integration with various message brokers
- CloudEvents 1.0 specification
- Message content type
- Content-based Routing
- Dead letter topics
- Namespace consumer groups
- Scoping topics

Competing consumers pattern



- Multiple application instances using a single consumer group
- Same app id = same consumer group
- Dapr delivers each message to only one instance of that application

Publish / Subscribe



POST
<http://localhost:3500/v1.0/publish/mybroker/order-messages>

POST
<http://localhost:5100/orders>

Pub/Sub Brokers

Generic

Component	Status	Component version	Since runtime version
Apache Kafka	Stable	v1	1.5
In-memory	Stable	v1	1.7
JetStream	Beta	v1	1.10
KubeMQ	Beta	v1	1.10
MQTT3	Stable	v1	1.7
Pulsar	Stable	v1	1.10
RabbitMQ	Stable	v1	1.7
Redis Streams	Stable	v1	1.0
RocketMQ	Alpha	v1	1.8
Solace-AMQP	Beta	v1	1.10

Amazon Web Services (AWS)

Component	Status	Component version	Since runtime version
AWS SNS/SQS	Stable	v1	1.10

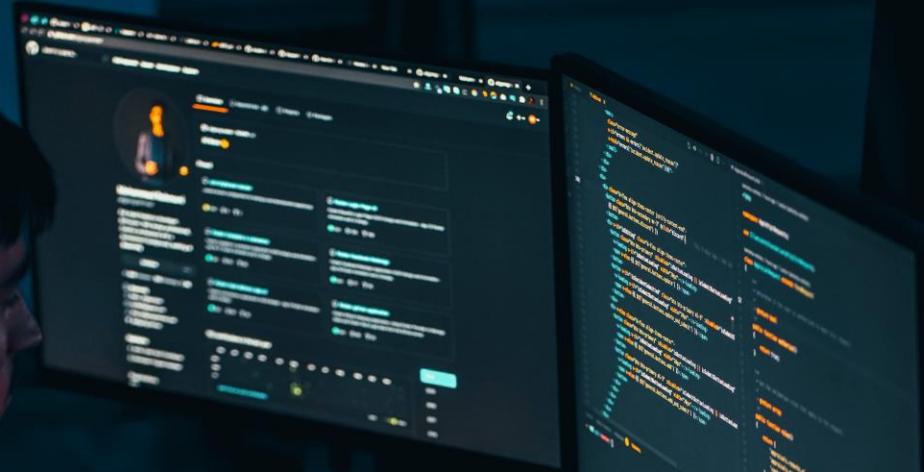
Google Cloud Platform (GCP)

Component	Status	Component version	Since runtime version
GCP Pub/Sub	Stable	v1	1.11

Microsoft Azure

Component	Status	Component version	Since runtime version
Azure Event Hubs	Stable	v1	1.8
Azure Service Bus Queues	Beta	v1	1.10
Azure Service Bus Topics	Stable	v1	1.0

DEMO



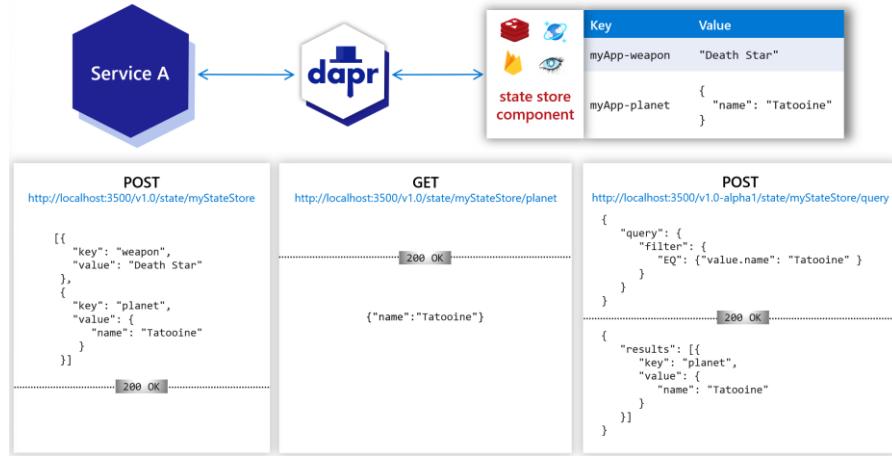
A close-up, low-angle shot of several rowers in a racing shell. Their hands are gripping yellow oars, which are angled downwards. The water is visible at the bottom, creating a sense of motion. The rowers are wearing blue and red athletic gear.

Dapr Building Blocks

State Management

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State Management



- Configurable state store behavior (default eventually consistent, last-write-wins concurrency pattern)
- Optimistic concurrency with ETag
- Time to live (TTL)
- State encryption
- Querying state

State Stores

Generic

Component	CRUD	Transactional	ETag	TTL	Actors	Query	Status	Component version	Since runtime version
Aerospike	✓	□	✓	□	□	□	Alpha	v1	1.0
Apache Cassandra	✓	□	□	✓	□	□	Stable	v1	1.9
CockroachDB	✓	✓	✓	✓	✓	✓	Stable	v1	1.10
Couchbase	✓	□	✓	□	□	□	Alpha	v1	1.0
etcd	✓	✓	✓	✓	✓	□	Beta	v2	1.12
Hashicorp Consul	✓	□	□	□	□	□	Alpha	v1	1.0
Hazelcast	✓	□	□	□	□	□	Alpha	v1	1.0
In-memory	✓	✓	✓	✓	✓	□	Stable	v1	1.9
JetStream KV	✓	□	□	□	□	□	Alpha	v1	1.7
Memcached	✓	□	□	✓	□	□	Stable	v1	1.9
MongoDB	✓	✓	✓	✓	✓	✓	Stable	v1	1.0
MySQL & MariaDB	✓	✓	✓	✓	✓	□	Stable	v1	1.10
Oracle Database	✓	✓	✓	✓	✓	□	Beta	v1	1.7
PostgreSQL v1	✓	✓	✓	✓	✓	✓	Stable	v1	1.0
PostgreSQL v2	✓	✓	✓	✓	✓	□	Stable	v2	1.13
Redis	✓	✓	✓	✓	✓	✓	Stable	v1	1.0
RethinkDB	✓	□	□	□	□	□	Beta	v1	1.9
SQLite	✓	✓	✓	✓	✓	□	Stable	v1	1.11
Zookeeper	✓	□	✓	□	□	□	Alpha	v1	1.0

Amazon Web Services (AWS)

Component	CRUD	Transactional	ETag	TTL	Actors	Query	Status	Component version	Since runtime version
AWS DynamoDB	✓	✓	✓	✓	✓	□	Stable	v1	1.10

Cloudflare

Component	CRUD	Transactional	ETag	TTL	Actors	Query	Status	Component version	Since runtime version
Cloudflare Workers KV	✓	□	□	✓	□	□	Beta	v1	1.10

Google Cloud Platform (GCP)

Component	CRUD	Transactional	ETag	TTL	Actors	Query	Status	Component version	Since runtime version
GCP Firestore	✓	□	□	□	□	□	Stable	v1	1.11

Microsoft Azure

Component	CRUD	Transactional	ETag	TTL	Actors	Query	Status	Component version	Since runtime version
Azure Blob Storage	✓	□	✓	□	□	□	Stable	v2	1.13
Azure Cosmos DB	✓	✓	✓	✓	✓	✓	Stable	v1	1.0
Azure Table Storage	✓	□	✓	□	□	□	Stable	v1	1.9
Microsoft SQL Server	✓	✓	✓	✓	✓	✓	Stable	v1	1.5

Oracle Cloud

Component	CRUD	Transactional	ETag	TTL	Actors	Query	Status	Component version	Since runtime version
Autonomous Database (ATP and ADW)	✓	✓	✓	✓	✓	✓	Alpha	v1	1.7
Object Storage	✓	□	✓	✓	✓	□	Alpha	v1	1.6

DEMO



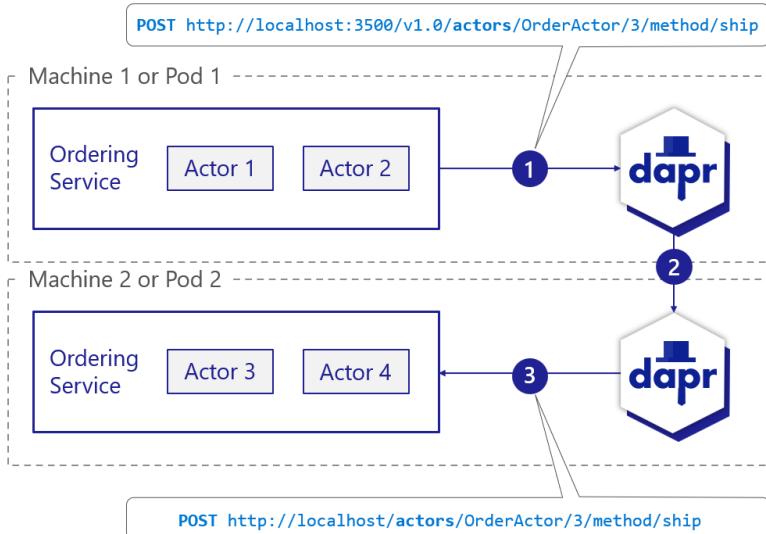
A close-up, low-angle shot of several rowers in a racing shell. Their hands are gripping yellow oars, which are angled downwards. The water is visible at the bottom, showing ripples and spray. The rowers are wearing blue and red athletic gear.

Dapr Building Blocks

Virtual Actors

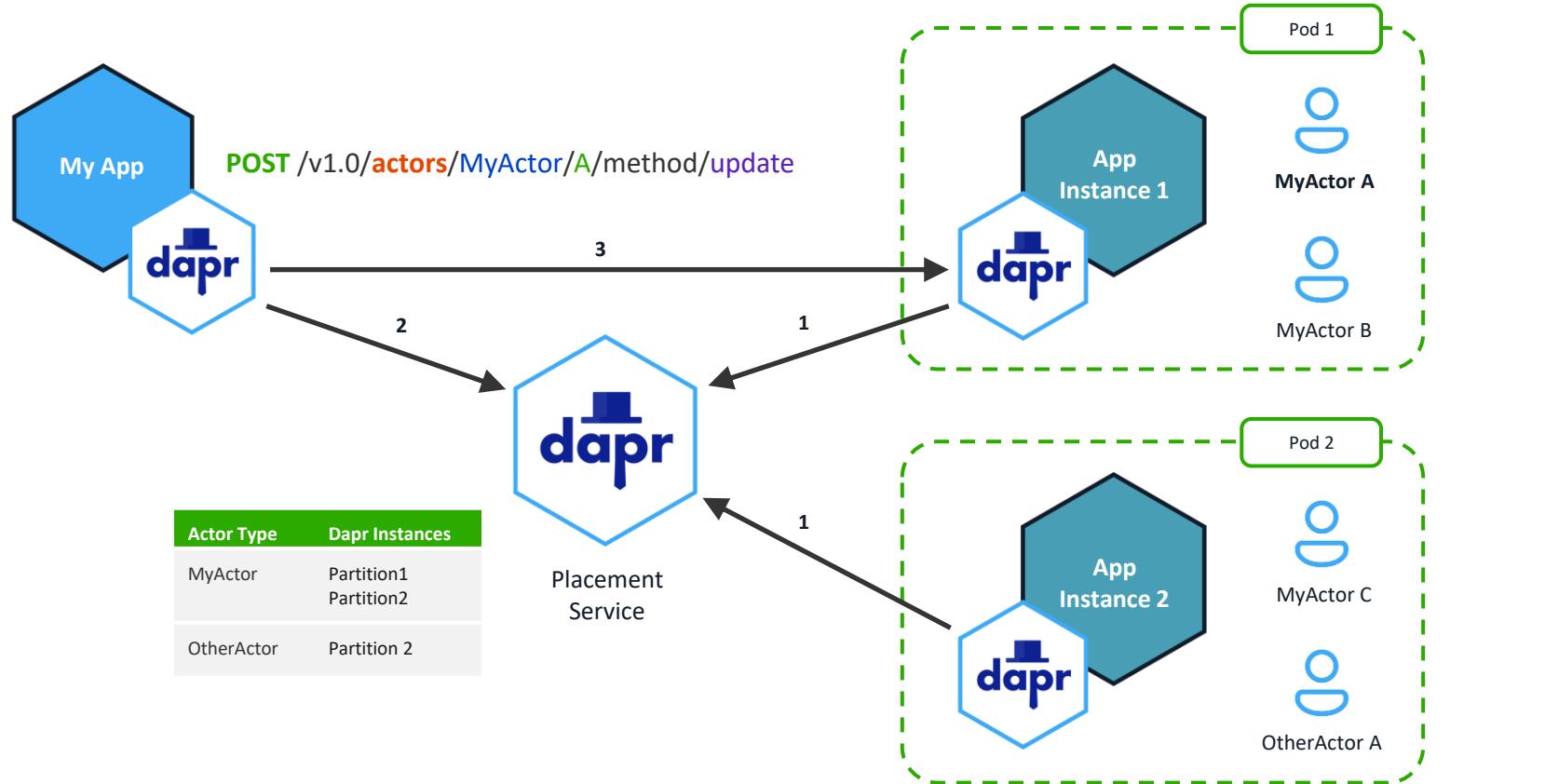
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Actors



- Virtual Actor pattern
- Stateful, long running objects with identity
- Encapsulate state and behavior within a distributed system
- Actor state store
- Actor timers and reminders

Actor placement



DEMO



A close-up, low-angle shot of several rowers in a racing shell. Their hands are gripping yellow and black oars, which are angled downwards. The water is visible at the bottom, creating a sense of motion. The rowers are wearing blue and red athletic gear.

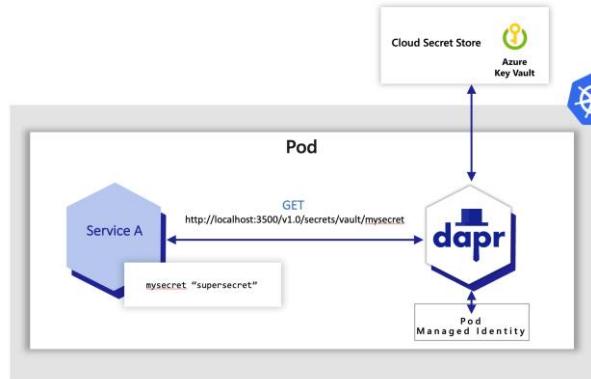
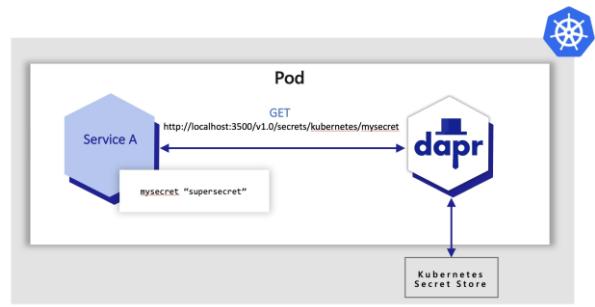
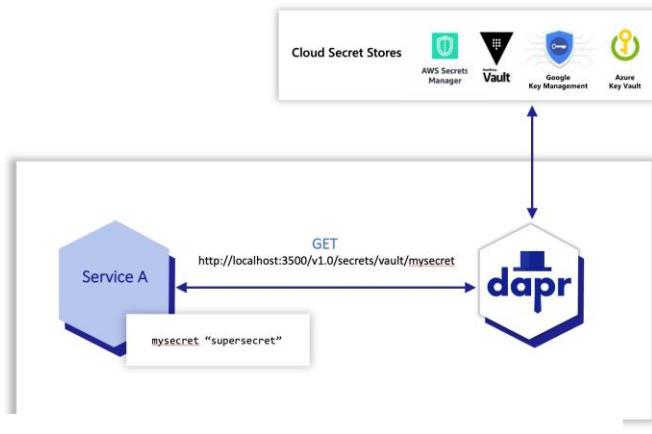
Dapr Building Blocks

Secret Management

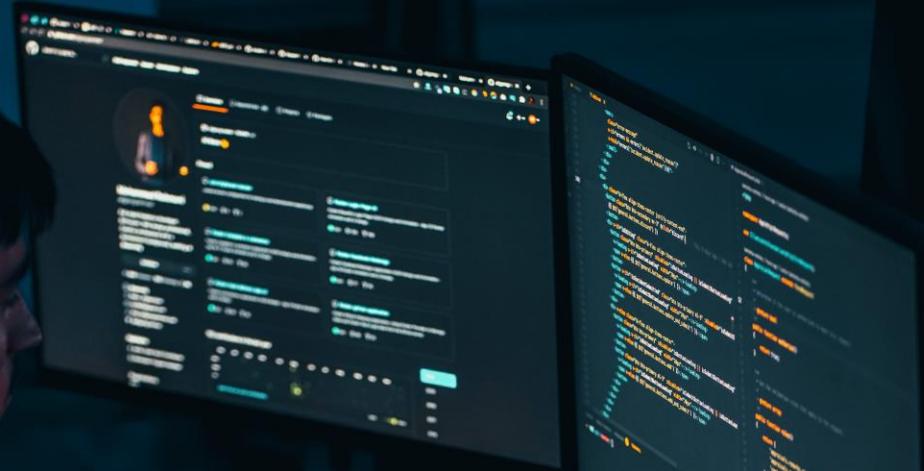
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Secret Management

- Access secret stores through generic Dapr API
- Secret scoping (limit access)



DEMO



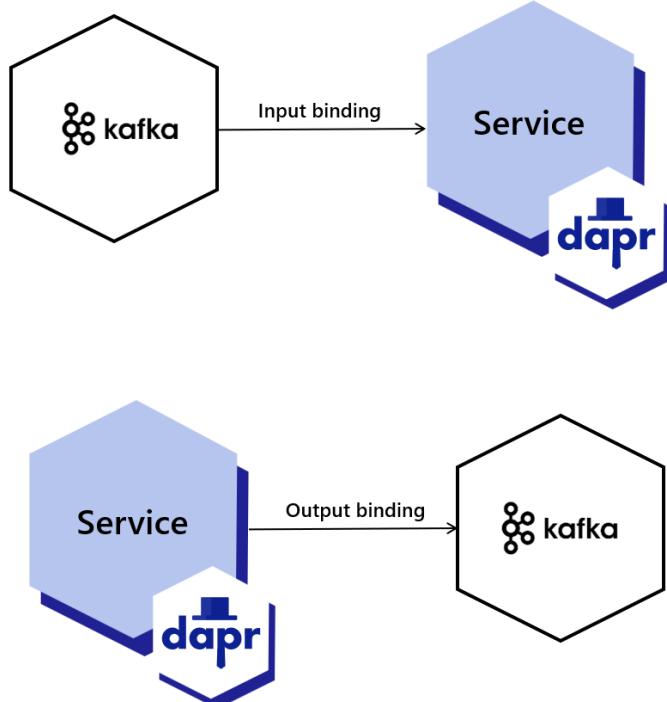
A close-up, low-angle shot of several rowers in a racing shell. Their hands are gripping yellow oars, which are angled downwards and to the side. The water is visible at the bottom, creating a sense of motion. The rowers are wearing blue and red athletic gear.

Dapr Building Blocks

Input/Output Bindings

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Input/Output Binding



- Trigger your app with events coming from external systems
- Handle retries and failure recovery
- Portable app with environment-specific bindings

Bindings

Generic

Component	Input Binding	Output Binding	Status	Component version	Since runtime version
Apple Push Notifications (APN)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Alpha	v1	1.0
commercetools GraphQL	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Alpha	v1	1.8
Cron (Scheduler)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Stable	v1	1.10
GraphQL	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Alpha	v1	1.0
HTTP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Stable	v1	1.0
Huawei OBS	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Alpha	v1	1.8
InfluxDB	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Beta	v1	1.7
Kafka	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Stable	v1	1.8
KiteX	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Alpha	v1	1.11
KubeMQ	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Beta	v1	1.10
Kubernetes Events	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Alpha	v1	1.0
Local Storage	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Stable	v1	1.9
MQTT3	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Beta	v1	1.7
MySQL & MariaDB	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Alpha	v1	1.0
PostgreSQL	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Stable	v1	1.9
Postmark	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Alpha	v1	1.0
RabbitMQ	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Stable	v1	1.9
Redis	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Stable	v1	1.9
RethinkDB	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Beta	v1	1.9
SendGrid	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Alpha	v1	1.0
SMTP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Alpha	v1	1.0
Twilio	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Alpha	v1	1.0
Wasm	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Alpha	v1	1.11

Microsoft Azure

Component	Input Binding	Output Binding	Status	Component version	Since runtime version
Azure Blob Storage	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Stable	v1	1.0
Azure Cosmos DB (Gremlin API)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Alpha	v1	1.5
Azure CosmosDB	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Stable	v1	1.7
Azure Event Grid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Beta	v1	1.7
Azure Event Hubs	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Stable	v1	1.8
Azure OpenAI	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Alpha	v1	1.11
Azure Service Bus Queues	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Stable	v1	1.7
Azure SignalR	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Alpha	v1	1.0
Azure Storage Queues	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Stable	v1	1.0

A close-up, low-angle shot of several rowers in a racing shell. Their hands are gripping yellow and black oars, which are angled downwards. The water is visible at the bottom, creating a sense of motion. The rowers are wearing blue and red athletic gear.

Dapr Building Blocks

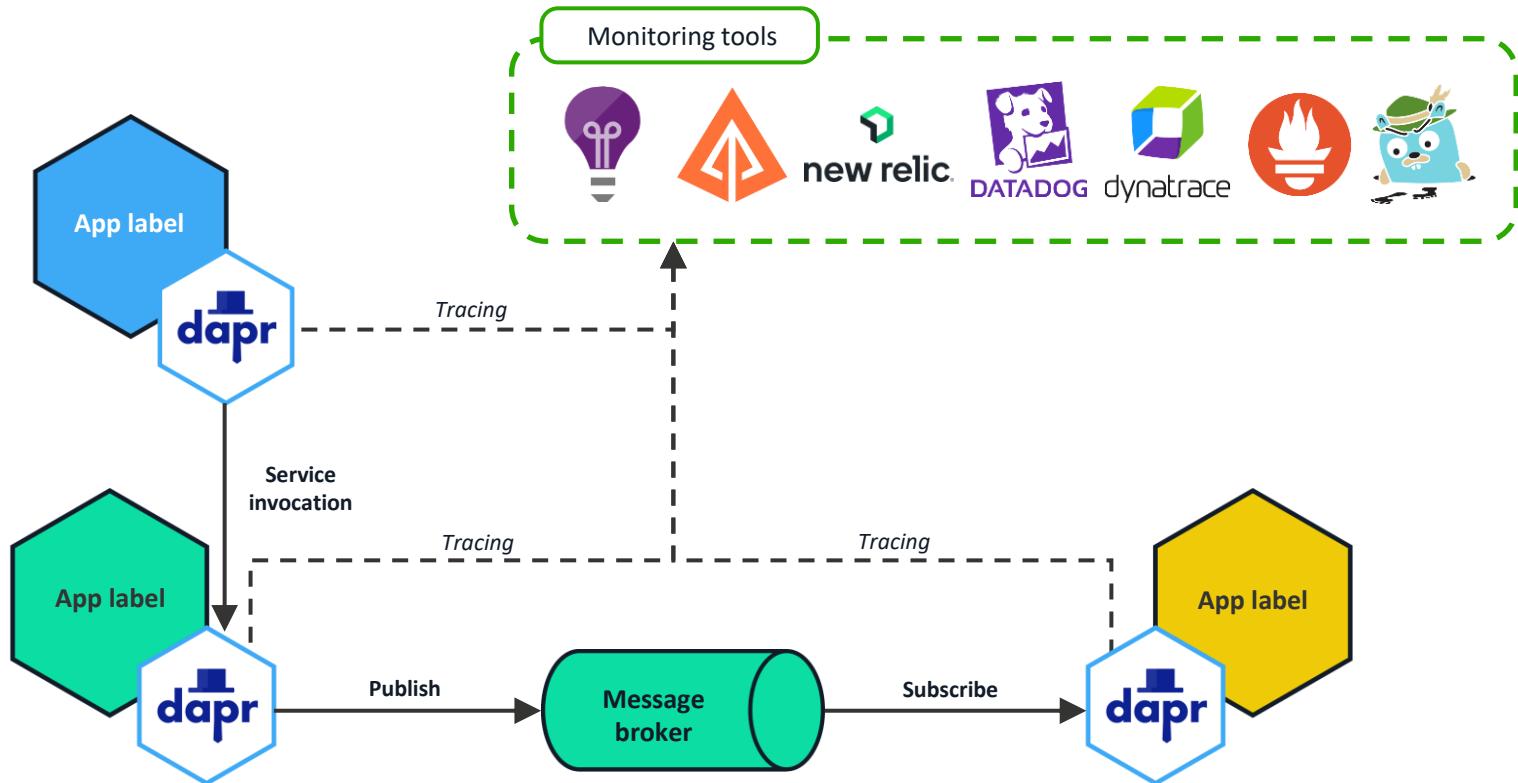
Observability

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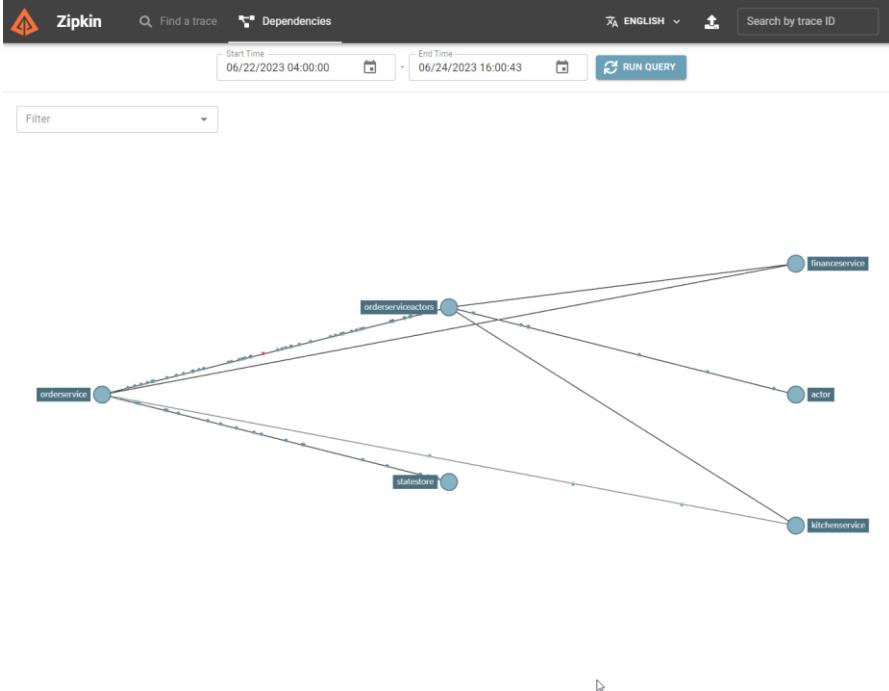
Distributed tracing



Observability



Observability



- Distributed tracing
- Open Telemetry (OTEL) and Zipkin protocols
- Used with service invocation and pub/sub APIs

- Sidecar health
- App health checks
 - Unsubscribing Pub/Sub
 - Stop input binings
 - Short-circuiting all service-invocation requests

A close-up, dynamic shot of several rowers in a team boat. Their hands are gripping yellow and black oars, which are angled downwards as they pull. Water splashes around the oars, indicating movement. The rowers are wearing blue athletic gear. The background is blurred, suggesting speed and motion.

Dapr Building Blocks

Resiliency

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Resiliency

Resiliency patterns can be applied across Dapr APIs:

- Retries
- Timeouts
- Circuit breakers

Declarative and decoupled from application code.

Available across all component types, service invocation, and actors.

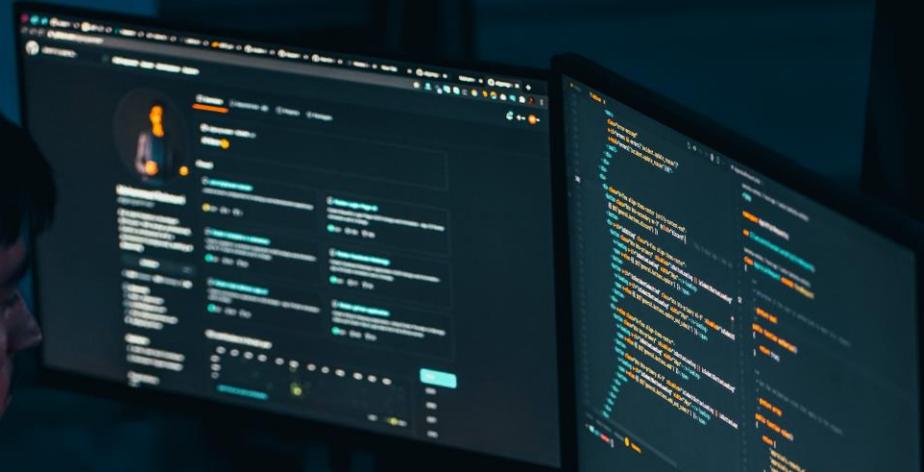
```
apiVersion: dapr.io/v1alpha1
kind: Resiliency
metadata:
  name: myresiliency
scopes:
  - order-processor

spec:
  policies:
    retries:
      retryForever:
        policy: constant
        duration: 5s
        maxRetries: -1

    circuitBreakers:
      simpleCB:
        maxRequests: 1
        timeout: 5s
        trip: consecutiveFailures >= 5

  targets:
    components:
      statestore:
        outbound:
          retry: retryForever
          circuitBreaker: simpleCB
```

DEMO



A photograph showing a team of rowers from behind, wearing blue and red athletic gear. They are in a boat, and their oars are visible as they dip into the water. The background is a bright, slightly overexposed sky.

.NET Microservices with Dapr

Conclusion

Pros / Cons

Advantages

- Develop faster
- Best practices
- Portability
- Focus on your logic

Disadvantages

- Additional hop / network overhead
- Common API – less features

Conclusion

- Suitable for most teams and applications
- Base your development on proven best practices
- Ideal, if portability is key (different environments / clouds, local, etc.)

A close-up, low-angle shot of several rowers in a boat, blurred to suggest motion. The rowers are wearing blue and red athletic gear. The oars have yellow handles and black blades.

.NET Microservices with Dapr

Q & A

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Thank you for your attention!

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A background photograph showing four hands of different skin tones coming together to hold four interlocking wooden puzzle pieces. The pieces are light brown, white, red, and green. The hands are positioned in the upper half of the frame, with one hand at the top center, two on the left, and one on the right.

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