DevDays 19

Lightweight Enterprise Java

With MicroProfile

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Agenda

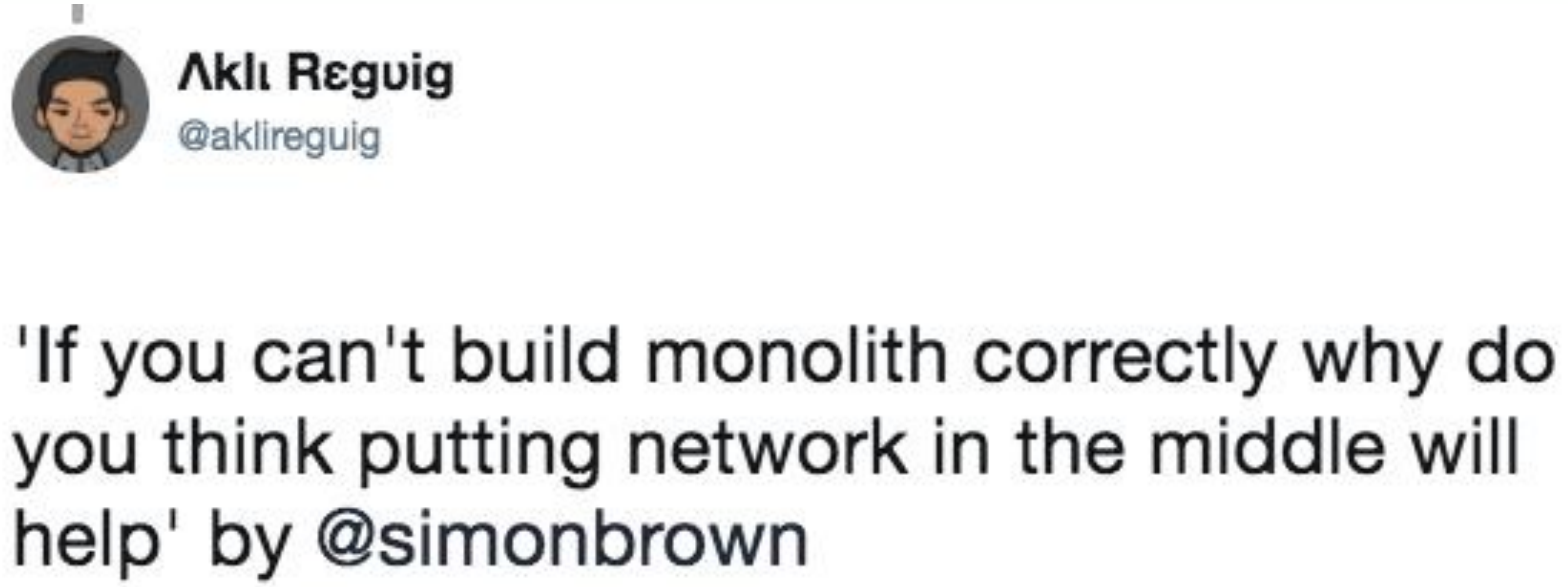
- Microservices!
- What is MicroProfile?
- Specs Overview
- Demos
- MicroProfile Future

Microservices Anyone?

What do people mean by Microservices?

- “Small autonomous services working together”
- “Small enough but not too small”
- “Can be written in 2 weeks”
- “Single responsibility principle”
- “Domain-driven design”

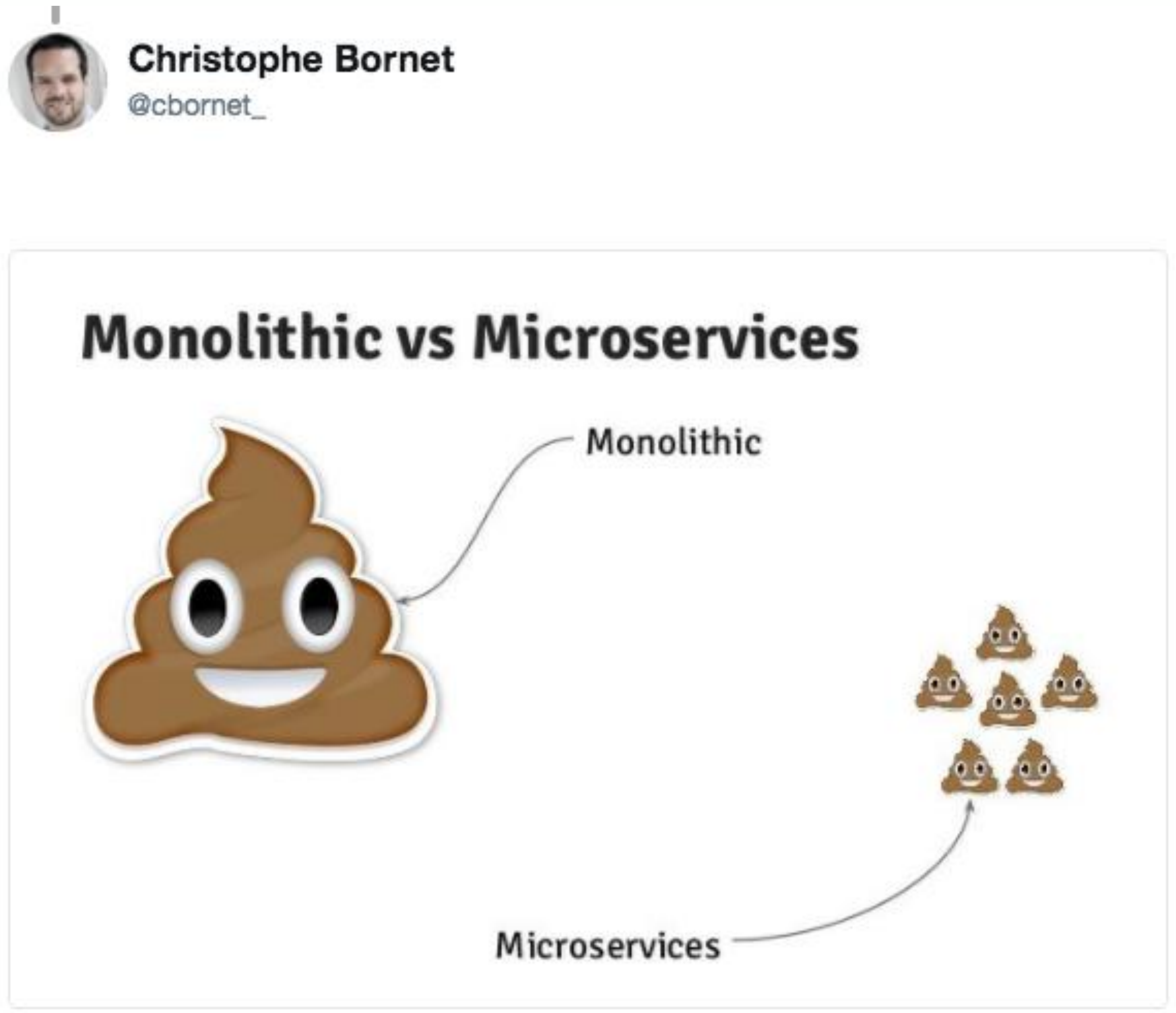
What do others think?



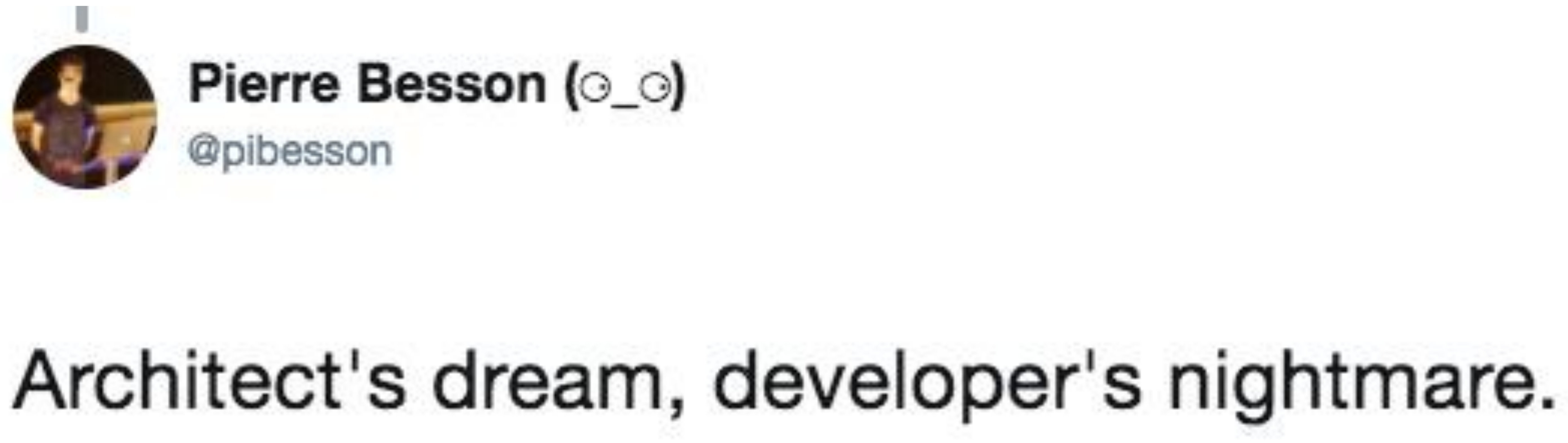
Λklı Rεgʋig
@aklireguig

'If you can't build monolith correctly why do you think putting network in the middle will help' by @simonbrown

What do others think?


Christophe Bornet
@cbornet_

What do others think?



Pierre Besson (◉_◉)
@pibesson

Architect's dream, developer's nightmare.

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Why Microservices?

- Deliver new features quicker
- Smaller, agile teams
- Scale services independently
- Cloud

Microservices Challenges

- Scalability
- Cost Reduction
- Resilience
- Monitoring
- Security

What is MicroProfile?

- http://microprofile.io/
- Enterprise Java for Microservices
- Open Source (Eclipse)
- 3 years old platform

What is MicroProfile?

- Initial version 1.0 with CDI, JAX-RS, JSON-P in Sep 2016
- Application portability across runtimes
- Currently at version 2.2 since Feb 2019
- Configuration, Fault Tolerance, JWT Propagation, Health Check, Metrics, Open Tracing, Open API and REST Client
- Reactive Streams released standalone

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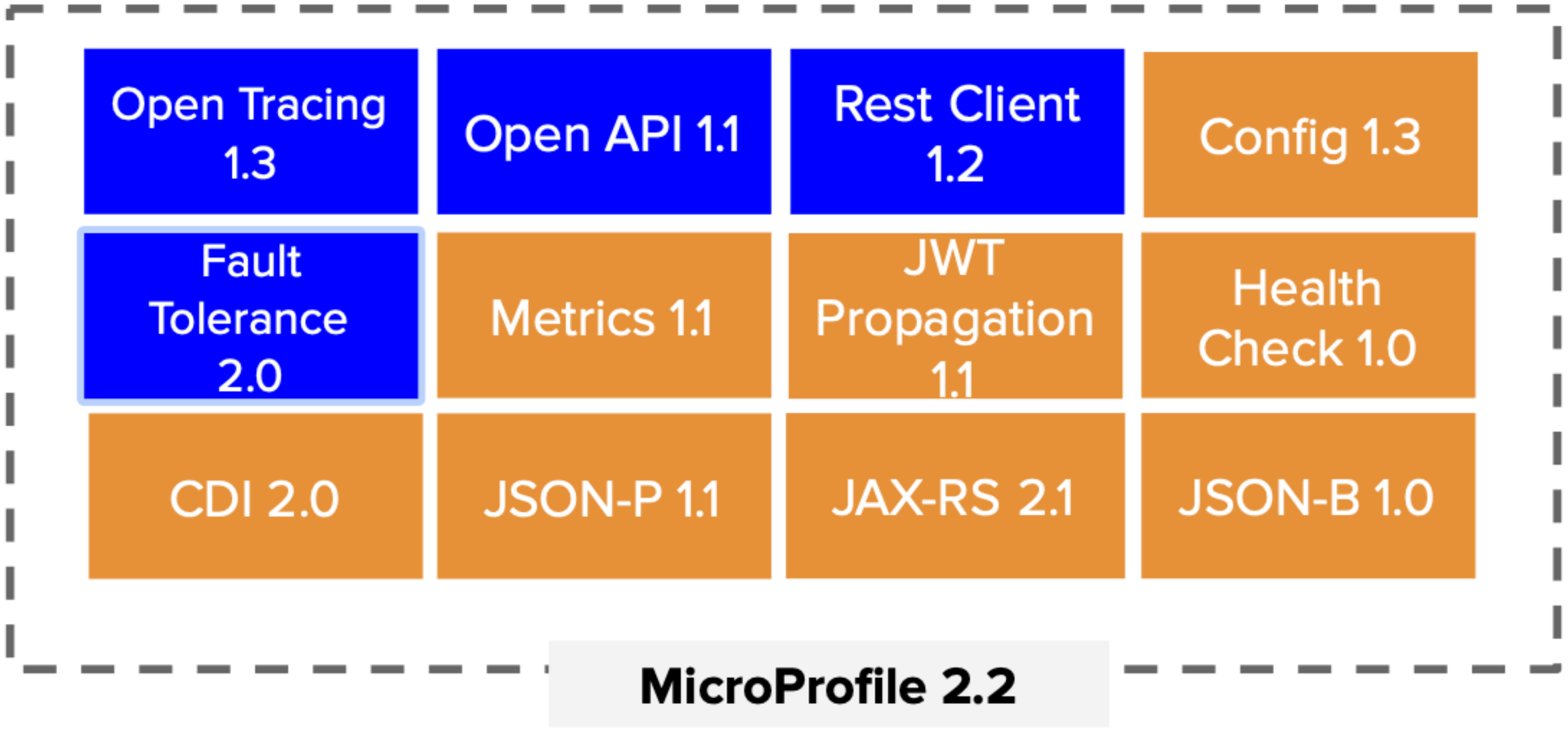
What is MicroProfile?

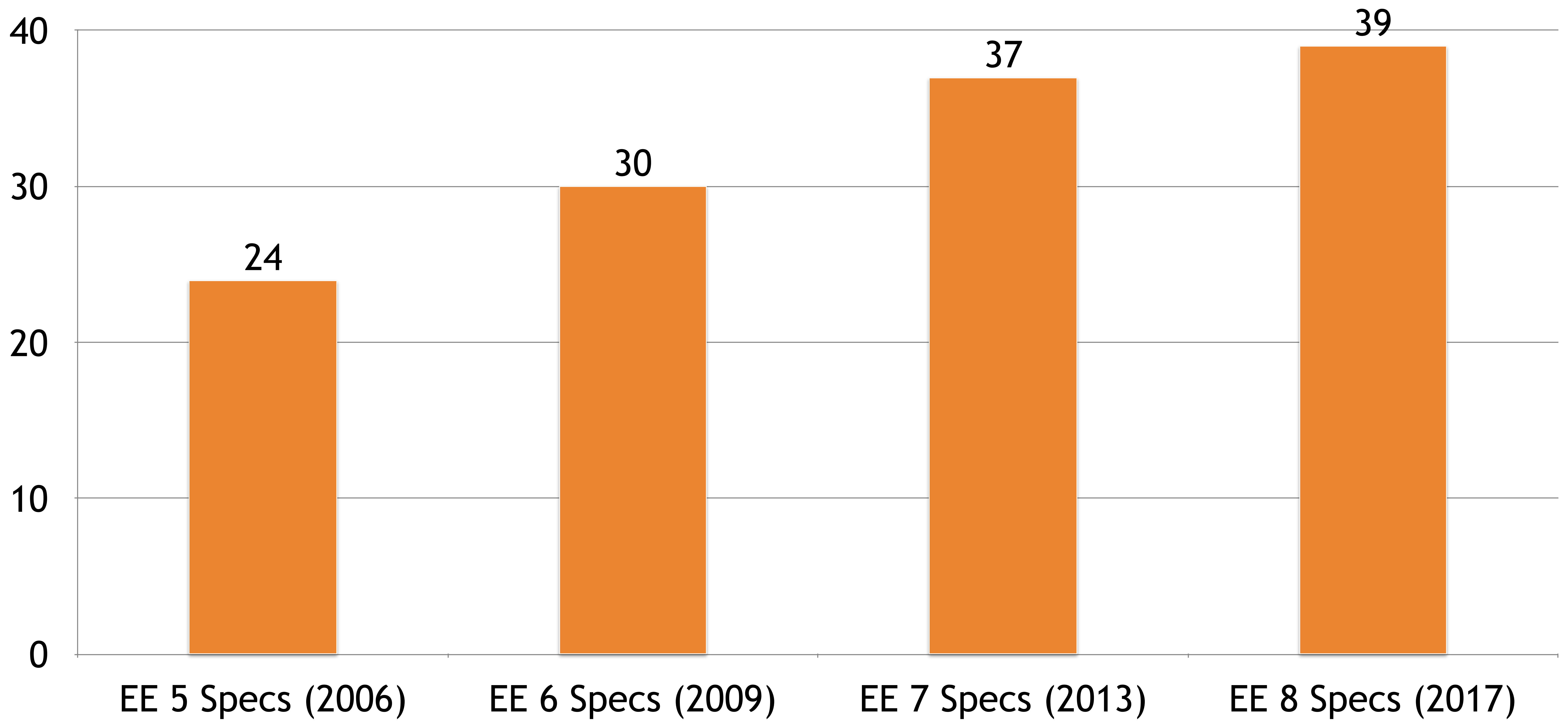


🟦 = New
🟦 = Updated
🟧 = No change from last release (MicroProfile 2.1)

Why MicroProfile?

- Slowdown in Java EE innovation
- Negative perception towards the technology
- Not prepared for Microservices development

Why MicroProfile?



Why MicroProfile?

- A set of “standards” were required to offer guidance in building Microservices in Java
- These need to evolve very quickly to adjust to the fast moving Microservices world
- A community of individuals, organisations and vendors collaborating to make this a reality

MicroProfile != EE (or Jakarta EE)

Who is involved in MicroProfile?

payara FUJITSU Tomitribe join the tribe

IBM redhat

LJC HAMMOCK SOUJava sociedade de usuários java Lightbend

Microsoft hazelcast ORACLE

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MicroProfile Implementations

payara

redhat.

Tomitribe
join the tribe

FUJITSU

IBM

HAMMOCK

ORACLE

My first MicroProfile App

CDI

- Contexts and Dependency Injection
- Bean Lifecycle and Typesafe Injection
- Producers
- Interceptors
- Observers

JAX-RS

- RESTful Web Services
- Annotation based
- HTTP Centric

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JSON-P

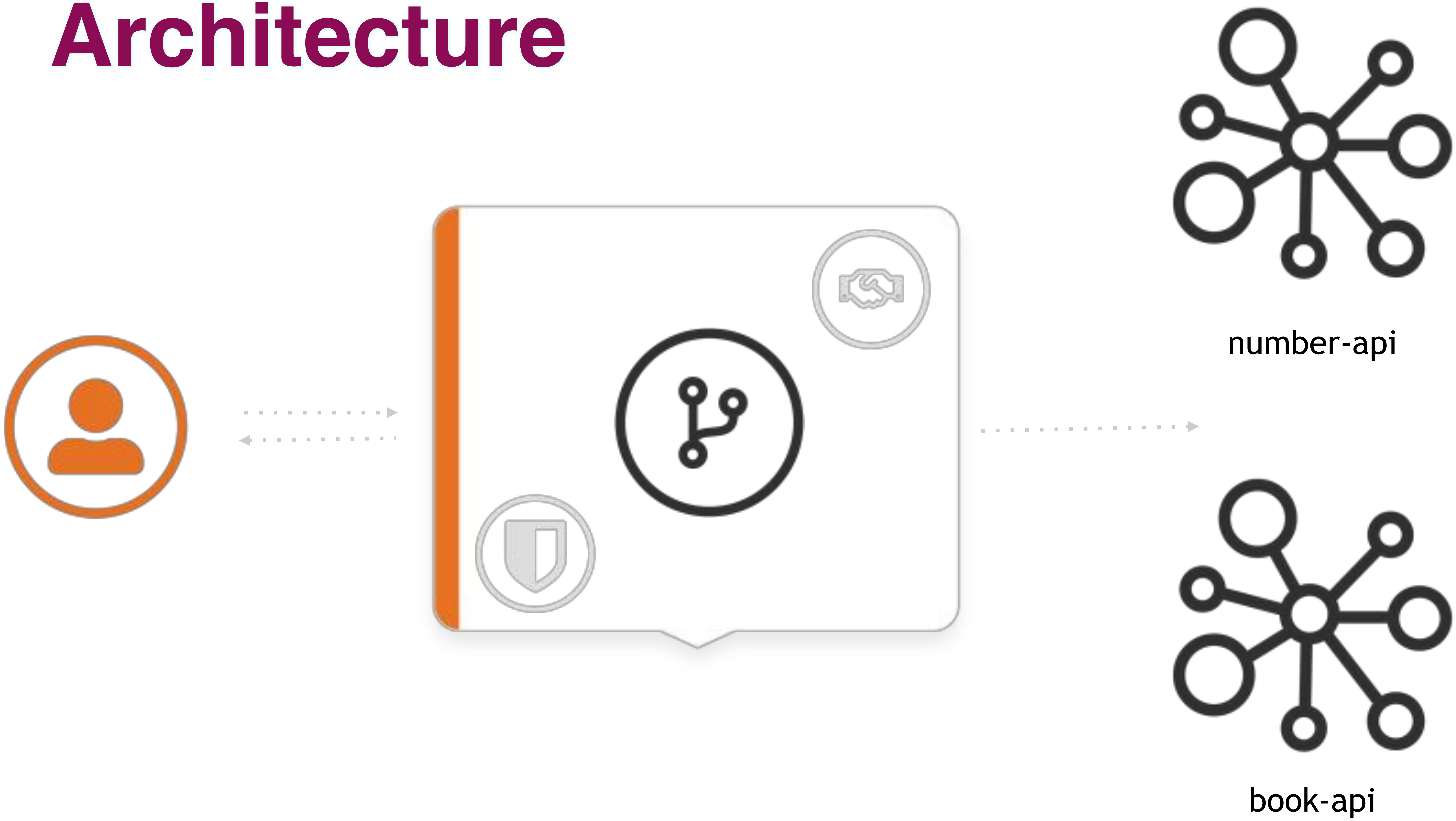
- Parse, Generate Transform and Query JSON
- Streaming API
- Object Model API

Putting it all together

```
@ApplicationScoped
@Path("books")
public class BookResource {
    @Inject
    private BookBean bookBean;

    @GET
    @Path("{id}")
    public Response findById(@PathParam("id") final Long id) {
        final Book book = bookBean.find(id);

        final JsonObjectBuilder builder =
                Json.createObjectBuilder()
                    .add("id", book.getId())
                    .add("name", book.getTitle());

     return Response.ok(builder.build().toString()).build();
    }
}
```

Evolving your MicroProfile App

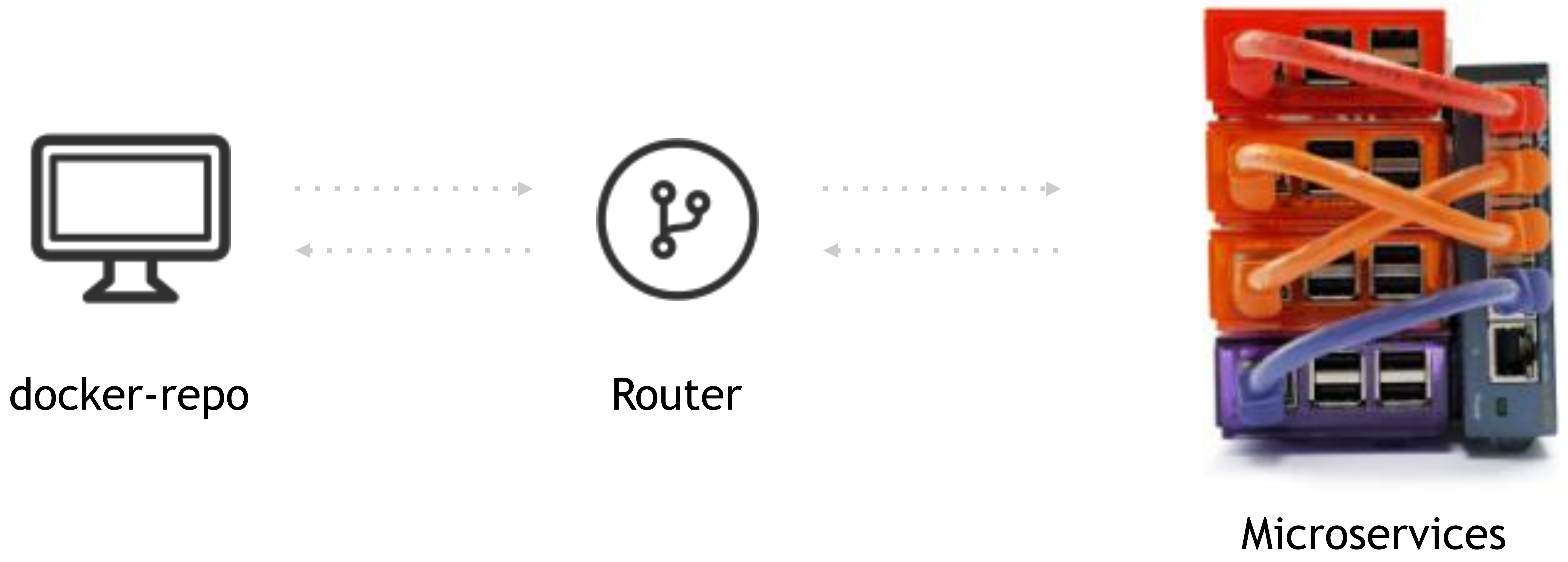
Architecture



Runtime

- Raspberry PI v3 (HypriotOS)
- Package everything with Docker
- Local Docker Registry
- Push Docker Images with Ansible

Deployment



MicroProfile Configuration

Configuration

- Applications need configuration based on their running environment
- It must be possible to change configuration without repacking the application
- Based on DeltaSpike Config, Apache Tamaya and Sabot

Configuration

- Standalone or in a CDI Container
- Default Values
- Supports the most common Java Type (including Optional)

Configuration

```
@Inject
@ConfigProperty(
   name="NUMBER_TARGET_API",
   defaultValue="http://localhost:8081/
   number-api/numbers/generate")
private String numberApiTargetUrl;
```

Configuration

```
Config config = ConfigProvider.getConfig();

final String url =
  config.getValue("NUMBER_TARGET_API",
    String.class);
```

Config Sources

- META-INF/microprofile-config.properties
- System properties
- Environment variables
- Pluggable to allow custom config sources and providers through the ServiceLoader mechanism

MicroProfile Fault Tolerance

Fault Tolerance

- Different strategies to guide the execution and result of some logic
- Inspired by Hystrix and Failsafe
- Supports Sync and Async execution

Fault Tolerance

- Depends on CDI
- Interceptor bindings
- Business method invocation
- Integrates with MP Config and Metrics

Timeout

- Prevents the execution from waiting forever
- Fail the execution if the timeout is hit
- Useful when calling other services

Retry

- Invoke the same operation again
- Specify criteria on when to retry
- Recover from network glitchs

Fallback

- Invoked when the original execution fails
- Specify when it fails
- Fallback to some other execution to prevent failures

Circuit Breaker

- Prevent repeated failures
- Fail fast
- Can be open, half-open or closed
- Protect services

Bulkhead

- Limit number of concurrent requests
- Access from multiple contexts
- Prevent failures from cascading

MicroProfile Healthchecks

Healthchecks

- Probe the state of a computer node
- Primary target cloud infrastructure
- Automated processes to maintain the state of nodes

Healthchecks

- Simple API to specify health status
- /health JAX-RS endpoint reporting server health
- Response status indicates if the health check passed
- Payload can include more detail

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Healthchecks

```
@Health
@ApplicationScoped
public class CheckDiskSpace implements HealthCheck {
    public HealthCheckResponse call() {

    }
}
```

Healthchecks

GET /health

```
{
  "outcome": "UP",
  "checks": [{
    "name": "diskspace",
    "state": "UP",
    "data": {
      "key": "freebytes",
      "freebytes": "126000000000"
    }
  }]
}
```

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Healthcheck Demo

MicroProfile Metrics

Metrics

- Monitor essential System Parameters
- Ensure reliable operation of software
- Monitoring endpoints to collect data

Metrics

- Accessible via REST interface
- /metrics/base for MP compliant servers
- /metrics/application for Application specific Metrics
- /metrics/vendor for Server specific metrics
- OPTIONS provides metadata, such as Unit of measure

GET /metrics/base

```
{
   "thread.count" : 33,
   "thread.max.count" : 47,
   "memory.maxHeap" : 3817863211,
   "memory.usedHeap" : 16859081,
   "memory.committedHeap" : 64703546
}
```

OPTIONS /metrics/base

```
{
  "fooVal": {
    "unit": "milliseconds",
    "type": "gauge",
    "description": "The average duration of foo requests during last 5
minutes",
    "displayName": "Duration of foo",
    "tags": "app=webshop"
  },
  "barVal": {
    "unit": "megabytes",
    "type": "gauge",
    "tags": "component=backend,app=webshop"
  }
}
```

Metrics

- @Counted
- @Metered
- @Timed
- @Gauge
- Histogram

Application Metrics

```
@GET
@Path("/{id}")
@Metered(name = "BookResource.findById_meter")
@Timed(name = "BookResource.findById_timer",
        unit = MetricUnits.MILLISECONDS,
        absolute = true)
public Response findById(@PathParam("id") final Long id) {
    ...
}
```

Meter

GET /metrics/application/{meter}

```
{
  "{meter}": {
    "count": 1,
    "fifteenMinRate": 0.2,
    "fiveMinRate": 0.2,
    "meanRate": 0.015384615384615385,
    "oneMinRate": 0.2,
    "unit": "per_second"
  }
}
```

Timed

GET /metrics/application/{timer}

```
{
  "{timer}": {
    "count": 1,
    "fifteenMinRate": 0.2,
    "fiveMinRate": 0.2,
    "max": 13644163,
    "mean": 13644163,
    "meanRate": 0.015384615384615385,
    "min": 13644163,
    "oneMinRate": 0.2,
    "p50": 13644163,
    "p75": 13644163,
    "p95": 13644163,
    "p98": 13644163,
    "p99": 13644163,
    "p999": 13644163,
    "stddev": 0
  }
}
```

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Counted

GET /metrics/application/{counter}

```
{
  "{counter}": 156825
}
```

Gauge

```
public class BookResource {

    private AtomicLong booksAdded = new AtomicLong();

    @Gauge(name="booksadded", unit = MetricUnits.NONE)
    public long count() {
        return booksAdded.get();
    }
}
```

Gauge

GET /metrics/application/{gauge}

```
{
  "{gauge}": 156825
}
```

Histogram

```
public class BookResource {
    @Inject
    @Metric(name = "bookcount")
    private Histogram histo;

    public void update(long count) {
        histo.update(count);
    }
}
```

MicroProfile OpenTracing

OpenTracing

- Trace the flow of a request across services
- OpenTracing is a distributed tracing standard for applications
- Java Binding to OpenTracing Implementation

OpenTracing

- JAX-RS calls are traced
- Context propagated to services called with REST client
  - X-B3-TraceId, X-B3-ParentSpanId, X-B3-SpanId
- Traces are collected and pushed to a database

OpenTracing

- Operations are measured in Spans
- Spans are grouped together into Traces

Tracing CDI Calls

```java
@Traced
@GET
@Path(“/books")
public Response findBooks() { }
```

OpenTracing

```
@ApplicationScoped
public class BookBean {

    @Inject
    private Tracer tracer;

    public Book create(final Book book) {
        final Span activeSpan = tracer.activeSpan();
        final Tracer.SpanBuilder spanBuilder = tracer.buildSpan("create");

        if (activeSpan != null) {
            spanBuilder.asChildOf(activeSpan.context());
        }

        final Span span = spanBuilder.withTag("created", true).start();
        tracer.scopeManager().activate(span, true);

    // do work
        span.finish();

        return book;
    }
}
```

Zipkin Demo

MicroProfile JWT Propagation

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Challenges in security

- Who is the caller?
- What can he do?
- How to propagate the security context?

JWT Propagation

- Security Tokens
- Most common: OAuth2, OpenID Connect JWT
- Lightweight way to propagate identities across different services

JWT Propagation

- Role based access control
- Keys (JWKS)
- Standard configuration (MP Config)

Goals

- Extract and verify the token
- Identify the caller
- Enforce authorization policies

What is a JWT?

- Pronounced “JOT”
- SAML like but less verbose
- Fancy JSON map
- BASE 64 URL encoded
- Digitally signed (RSA-SHA256, HMAC-SHA512, etc)
- Possibly encrypted
- Built-in expiration

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```
@LoginConfig(authMethod = "MP-JWT")
public class ApplicationConfig extends Application {
    // let the server discover the endpoints
}

—
@Inject
private JsonWebToken jwtPrincipal;

@Context
private SecurityContext securityContext;

@Inject
@Claim("username")
private ClaimValue<String> username;

@Inject
@Claim("email")
private ClaimValue<String> email;

—
@RolesAllowed("create")
public Response create(final Book book, @Context UriInfo uriInfo) {
 ...
}
```

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MicroProfile OpenAPI

Open API

- Java API for the OpenAPI v3 specification
- OpenAPI v3 is based on Swagger v2
- Annotations should be similar

Configuration

```
@GET
@Path("/{id}")
@Operation(summary = "Find a Book by Id")
@APIResponse(responseCode = "200",
  content = {@Content(schema =
   @Schema(implementation = Book.class))})
public Response findById(@PathParam("id") final Long id) {
    return bookBean.findById(id)
                .map(Response::ok)
                .orElse(status(NOT_FOUND))
                .build();
}
```

GET /openapi

```
paths:
  /books/{id}:
    get:
      parameters:
      - name: "id"
        required: true
        style: "simple"
        schema:
          readOnly: false
          deprecated: false
          description: "The id of the Book"
          writeOnly: false
      deprecated: false
      summary: "Find a Book by Id"
      responses:
        200:
          content:
            application/json:
              schema:
        …
          description: ""
      operationId: "findById"
```

OpenAPI Demo

MicroProfile REST Client

REST Client

- Microservices typically talk REST to other services
- Several JAX-RS implementations already support interface definition
- Consistent and easy to reuse

REST Client

- Type safe REST Service over HTTP
- Extends JAX-RS 2.0 API's
- More natural code style
- Similar to Feign

Configuration

```
@RegisterRestClient
@Path("/books")
public interface BookService {
  @GET
  @Path("/{id}")
  Response findById(@PathParam("id") final Long id);
}

@ApplicationScoped
public class BookStore {
     @Inject
     @RestClient
     private BookService client;
}
```

MicroProfile Starter

https://start.microprofile.io

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Future

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MicroProfile Roadmap

- MicroProfile 3.0 by June 2019
- Major updates to Health and Metrics
- GraphQl, Long Running Actions, Concurrency, Reactive Messaging, Event Data, Reactive Relational DB Access

Get Involved

Resources

- http://microprofile.io/
- http://tomee.apache.org
- https://github.com/radcortez/microprofile-samples

Thank you!