JAX-RS.next

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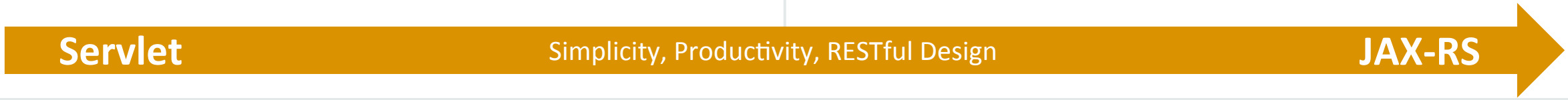
HTTP in Java EE: From Servlet to JAX-RS

- Generic
  - Protocol-independent
  - In retrospect, most important Java EE technology
    - But brought HTTP to Java EE
- Old-school Programming Model
  - Static, Interface-driven
  - Singleton-Scoped
  - Lot's of distractions / boilerplate

- Laser-focused on REST Services
  - HTTP Centric
    - method matching, content negotiation, …
  - Payload format independence
    - decoupled from business logic
- Modern Programming Model
  - Dynamic, POJO-based, Annotation-driven
  - Request-Scoped
  - No distractions / boilerplate



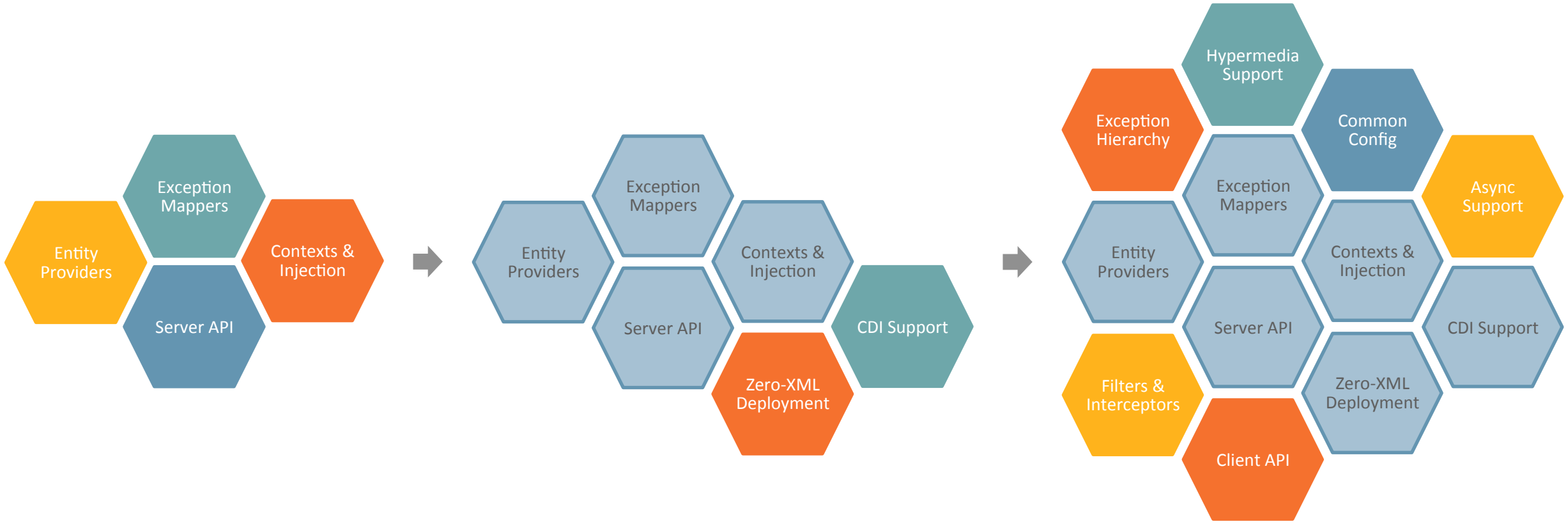
HTTP in Java EE: From Servlet to JAX-RS

```
public class MyServlet extends HttpServlet {
  protected void doGet(HttpServletRequest req, HttpServletResponse res) {
        if (!acceptsTextPlain(req)) {
             res.sendError(406); // Not Acceptable
             return;
        }
        if (!isGreetingPath(req)) {
            res.sendError(404); // Not Found
            return;
        }
        String name = req.getParameter("name");
        if (name == null) { name = "Joe"; }
        PrintWriter pw = res.getWriter();
        pw.print("Hi " + name + "!");
        pw.flush();
    }
    … // TODO: acceptsTextPlain(…) & isGreetingPath(…) implementations
}
```

```
@Path("greeting")
public class MyResource {
    @GET @Produces("text/plain")
    public String greet(@QueryParam("name") @DefaultValue("Joe") String name) {
        return "Hi " + name + "!";
    }
}
```

Servlet Simplicity, Productivity, RESTful Design **JAX-RS**

Evolution of JAX-RS API



JAX-RS 1.0 **JAX-RS 1.1** **JAX-RS 2.0**

JSR-370 – JAX-RS.next

- Performance
  - Reactive Programming Model
  - Java SE 8 Streams
  - Non-blocking I/O
- Java EE Alignment
  - CDI Alignment
  - Declarative Security Model
  - MVC 1.0 & JSONB 1.0 Integration
- Filling the Gaps
  - Server-Sent Events
  - Improved Hypermedia Support

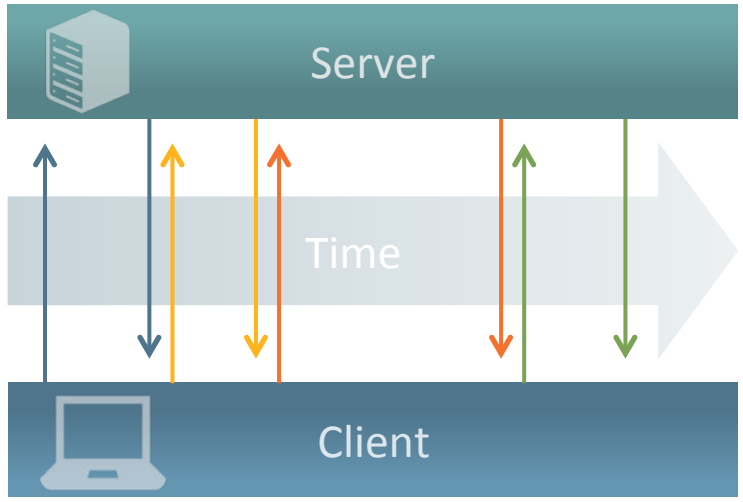
- Continued Evolution
  - All simple problems have already been solved…
- Targeted to Ship with Java EE 8

Program Agenda

1. Server-Sent Events
2. Non-Blocking I/O
3. Declarative Security
4. MVC Integration
5. CDI Alignment, JSON-B, …

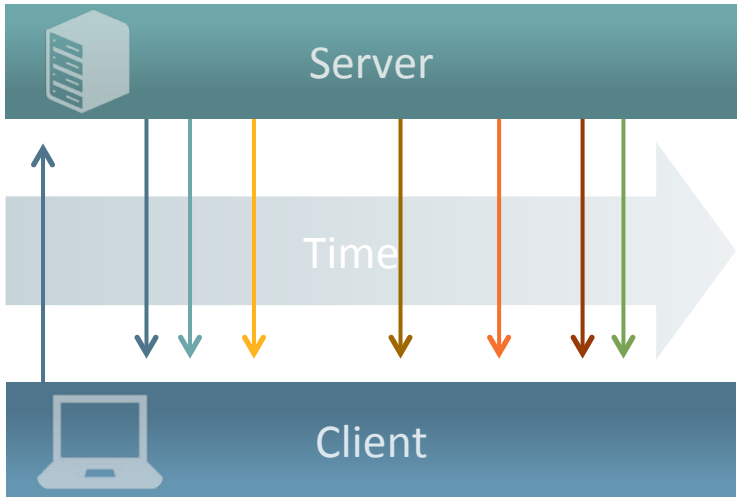
Ajax Long-Polling vs. Server-Sent Events vs. WebSocket

Ajax Long-Polling



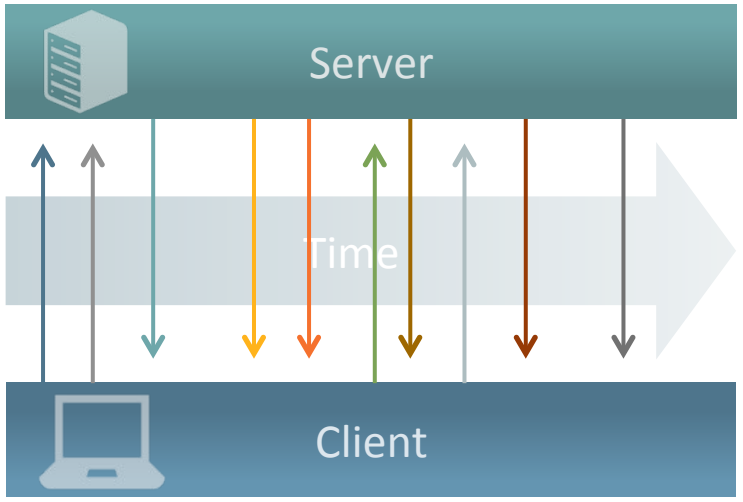
- Plain old HTTP
- Manual reconnect
- Undefined format

Server-Sent Events



- Plain old HTTP
- Seamless reconnect & redelivery
- HTML 5 standard protocol

WebSocket



- New Protocol (via HTTP upgrade)
- Full-duplex
- HTML 5 standard protocol

Why Server-Sent Events?

- Streaming asynchronous events from Server to Client

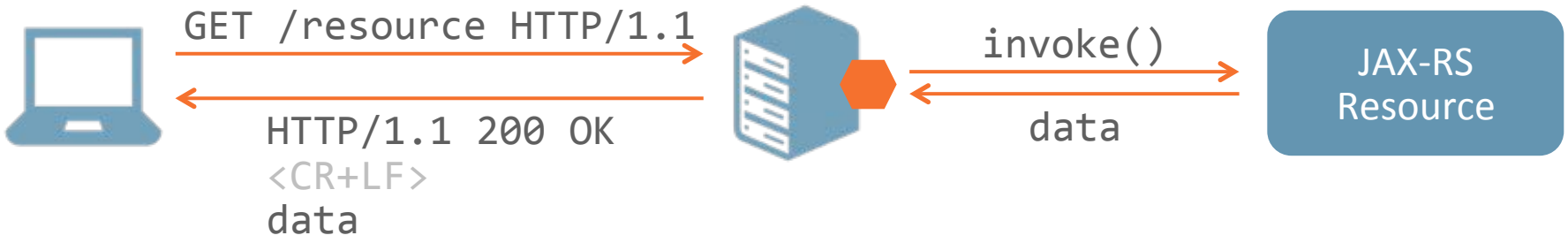
- Fits well Ajax Long-Polling Use Cases
  - Progress for long-running tasks
  - Stream of real-time data updates (e.g. Stock Ticker, Monitoring)
  - Instant server state change notifications (e.g. SysAdmin Message Push)
  - Task processing distribution
  - …

- Part of HTML5 Standard by W3C
  - Built-in support in all modern browsers
  - Standard event message format

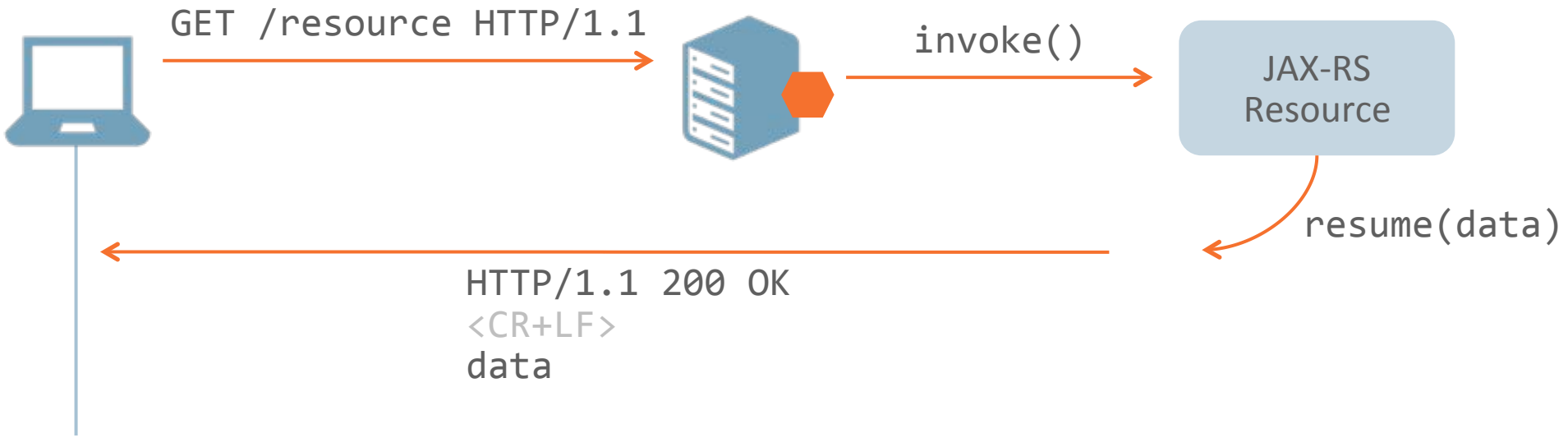
An SSE Event Message

```
: Comment lines start with a ‘:’ prefix
: Events can have numeric IDs…
id: 1234
: …can contain reconnect delay instructions…
retry: 5000
: …can be named…
event: text-message
: …typically contain one or more lines of event payload data.
data: Hello, this is a
data: multi-line message.
: Events are separated from each other by a blank line.
<blank line>
```

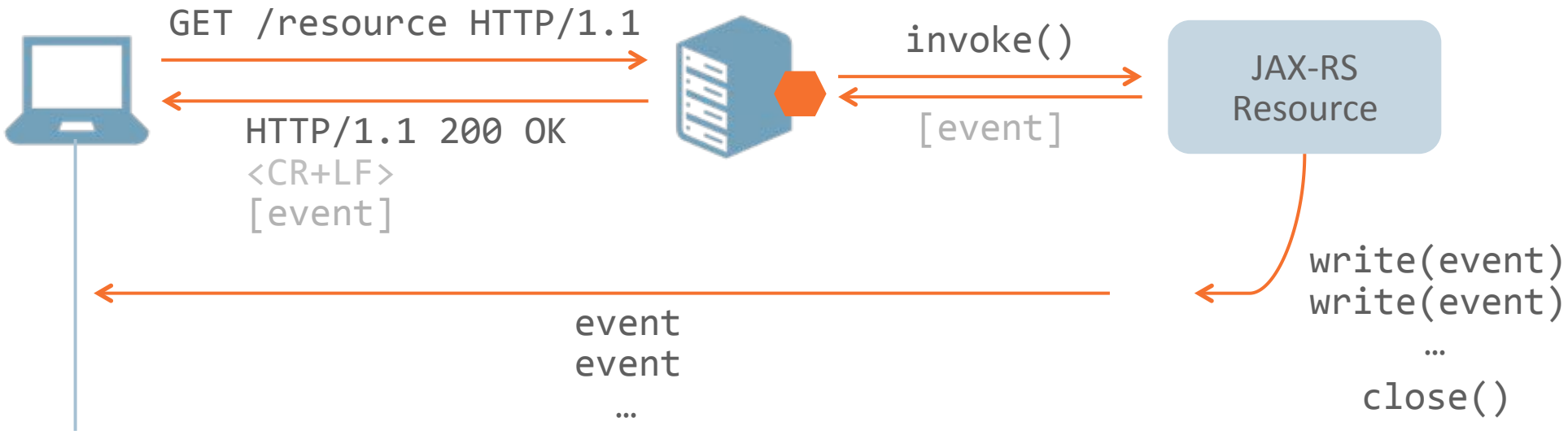
Typical HTTP Request / Response Flow



Asynchronous HTTP Request / Response Flow



Server-Sent Events Flow



Jersey Server-Sent Events API

Producer API – Server side

`OutboundEvent`

- single event; outgoing

`EventOutput`

- single client connection; outbound

`SseBroadcaster`

- connection aggregation
- `BroadcasterListener`
  - broadcast notification

Consumer API – Client side

`InboundEvent`

- single event; incoming

`EventInput`

- streaming connection; inbound

`EventSource`

- IoC connection; inbound
- `EventListener`
  - asynchronous event processing

Server-side – Connecting to an Event Source

```
@Path("messages")
@Produces(APPLICATION_JSON)
public class MessageBoardResource {

    private static SseBroadcaster broadcaster = new SseBroadcaster();

    @GET @Path("stream")
    @Produces(SseFeature.SERVER_SENT_EVENTS)
    public EventOutput connect() {

        EventOutput eventOutput = new EventOutput();
        broadcaster.add(eventOutput);
        return eventOutput;

    }

    …
```

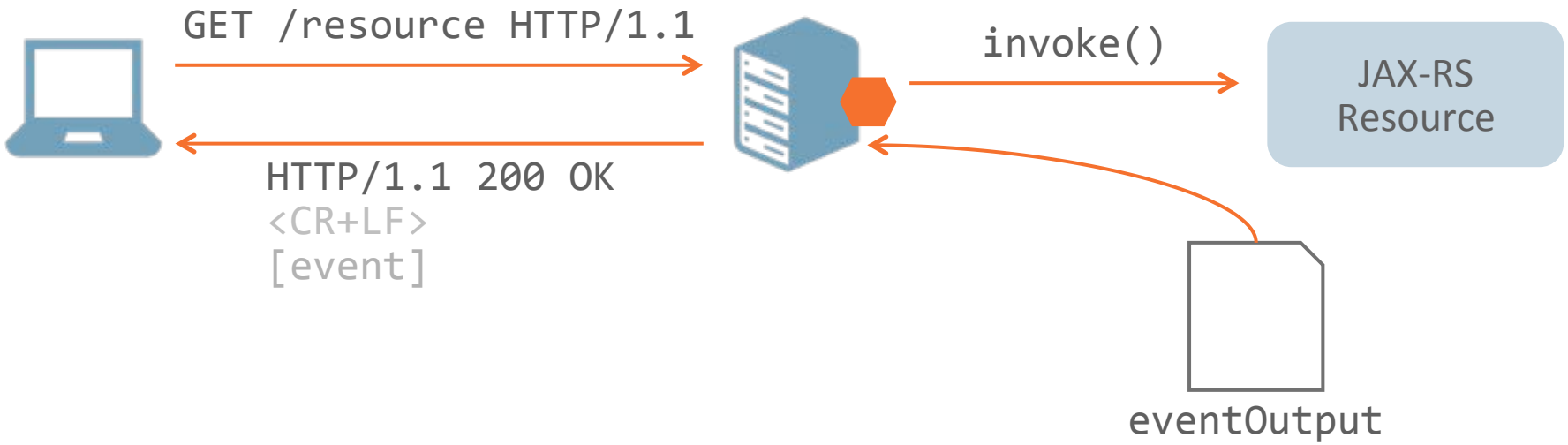
Create Broadcaster

Create Outbound Connection

Store Outbound Connection

Return Outbound Connection

Server-Sent Events Flow



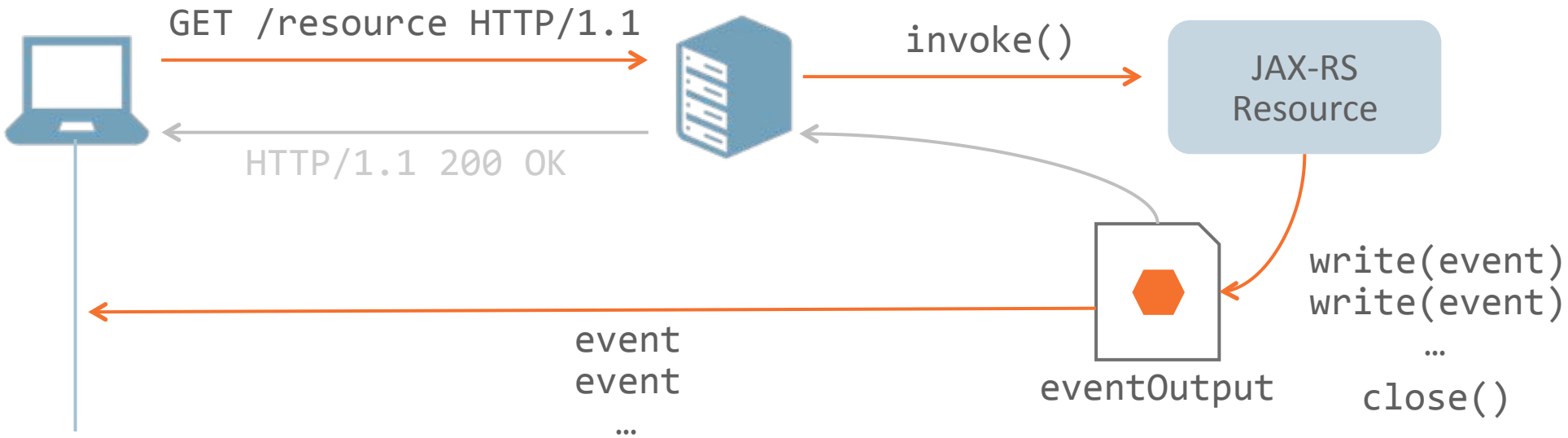
Server-side – Dispatching Events

```
    …

    @POST
    @Consumes(MediaType.APPLICATION_JSON)
    public String postMessage(Message message) {

        OutboundEvent event = new OutboundEvent.Builder()
                .id(getNextId())
                .mediaType(MediaType.APPLICATION_JSON_TYPE)
                .data(Message.class, message)
                .build();


        broadcaster.broadcast(event); // invokes eventOutput.write(event);

        return "Message posted!"
    }
}
```

Create Outbound Event

Send Outbound Event

Server-Sent Events Flow



Client-side Event Processing – IoC Model

```
EventSource eventSource =
    new EventSource(target.path("messages/stream")) {

        @Override
        public void onEvent(InboundEvent event) {

            String name = event.getName();
            Message message = event.readData(Message.class);

            display(name, message);
        }
    };

…

eventSource.close();
```

Create Event Source

Implement Event Callback

Process Inbound Event

Close Event Source

Client-side Event Processing – Pull Model

```
EventInput events = target.path("messages/stream")
                          .request().get(EventInput.class);

while (!stop) {

    InboundEvent event = events.read();
    String name = event.getName();
    Message message = event.readData(Message.class);

    display(name, message);
}

events.close();
```

Retrieve Event Stream

Implement Event Loop

Process Inbound Event

Close Event Source

Program Agenda

1. Server-Sent Events
2. Non-Blocking I/O
3. Declarative Security
4. MVC Integration
5. CDI Alignment, JSON-B, …

Servlet 3.1 Non-Blocking I/O API

- Receiving data
  - `ServletInputStream`
    - `isReady()`, `isFinished()`, `setReadListener(ReadListener)`
  - `ReadListener`
    - `onDataAvailable()`, `onError(Throwable)`, `onAllDataRead()`

- Sending data
  - `ServletOutputStream`
    - `isReady()`, `setWriteListener(WriteListener)`
  - `WriteListener`
    - `onWritePossible()`, `onError(Throwable)`

Non-Blocking I/O API in JAX-RS

- Main Constraints and Goals
  - Backward-compatibility
  - Alignment with Servlet 3.1 Non-Blocking I/O API
    - At least conceptually
  - Support for standalone JAX-RS deployments
    - no hard dependency on Servlet API

- Problems to solve
  - Unclear impact on request/response processing chain
  - Multiple extension points to cover (in a backward-compatible way)
    - Filters, Interceptors, Entity Providers, Exception Mappers, Parameter Converters
    - Potential interoperability issues in mixed models
      - e.g. blocking and non-blocking request filter in the same processing chain

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Securing Resources in JAX-RS

- New Security JSR planned for Java EE 8
  - Focused on unification, ease of use and portability improvements
  - JAX-RS EG will monitor progress of this JSR
- OAuth 2.0 gaining a lot of adoption from many big players
  - Google, Facebook, Twitter, …
- Vision for REST Services Security Model in Java EE
  - Easy and Straightforward
  - Declarative whenever possible
    - Java EE Security Annotations fit JAX-RS very well
    - Jersey already provides annotation-based authorization

Existing Jersey Security Features

- Leveraging standard JAX-RS extension points
- Off-the-shelf modules & components ready to use

- Client-side
  - HTTP Basic & Digest Authentication Support
- Server-side
  - Declarative Role-base Authorization (`javax.annotation.security`)
    - `@RolesAllowed`, `@PermitAll`, `@DenyAll`

- OAuth 1.0, 2.0 Support
  - Client and Server Side

Authorization in Jersey

```
@Path("messages")
@Produces(APPLICATION_JSON)
@DenyAll
public class MessageBoardResource {
    …

    @GET @Path("stream")
    @Produces(SseFeature.SERVER_SENT_EVENTS)
    @PermitAll
    public EventOutput connect() { … }

    @POST
    @Consumes(MediaType.APPLICATION_JSON)
    @RolesAllowed("publisher")
    public String postMessage(Message message) { … }
}
```

No access by default

Public access

Only "publisher" role

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1. Server-Sent Events
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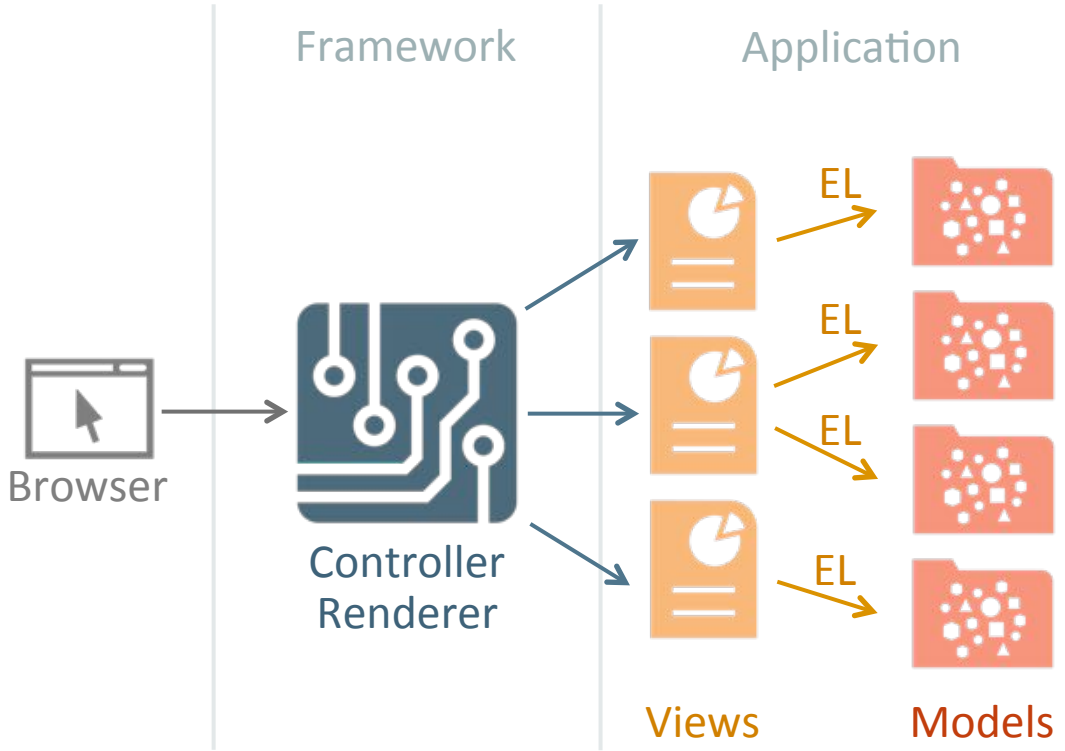
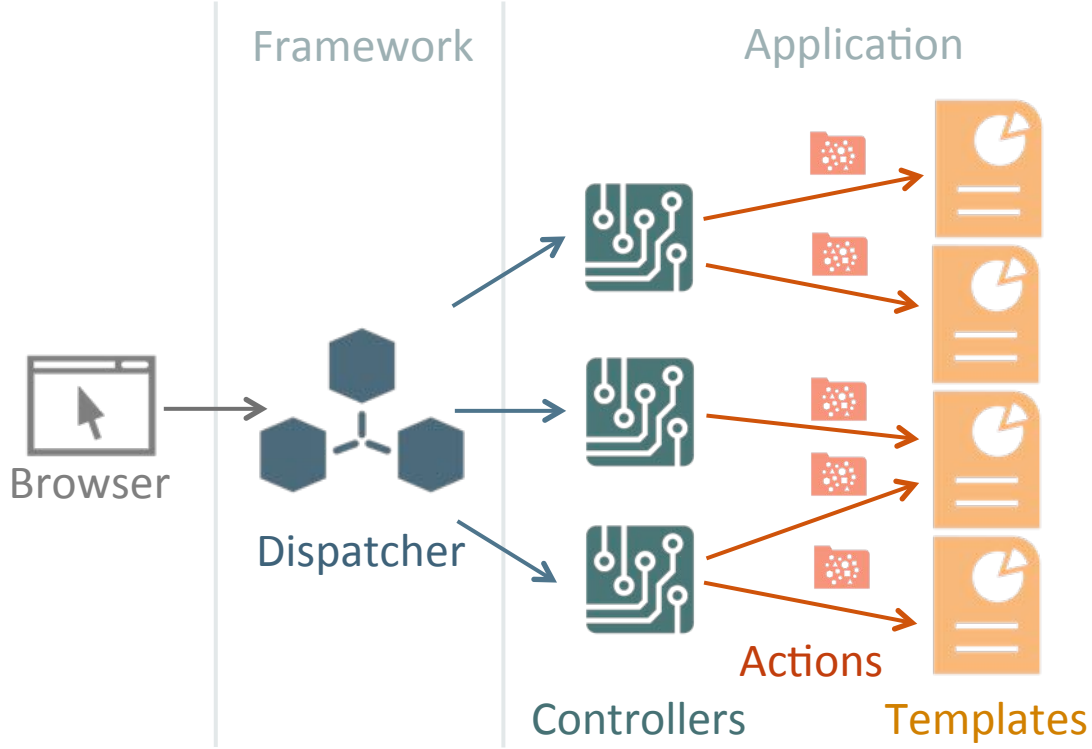
Different Tastes of MVC Frameworks

UI Component-Oriented



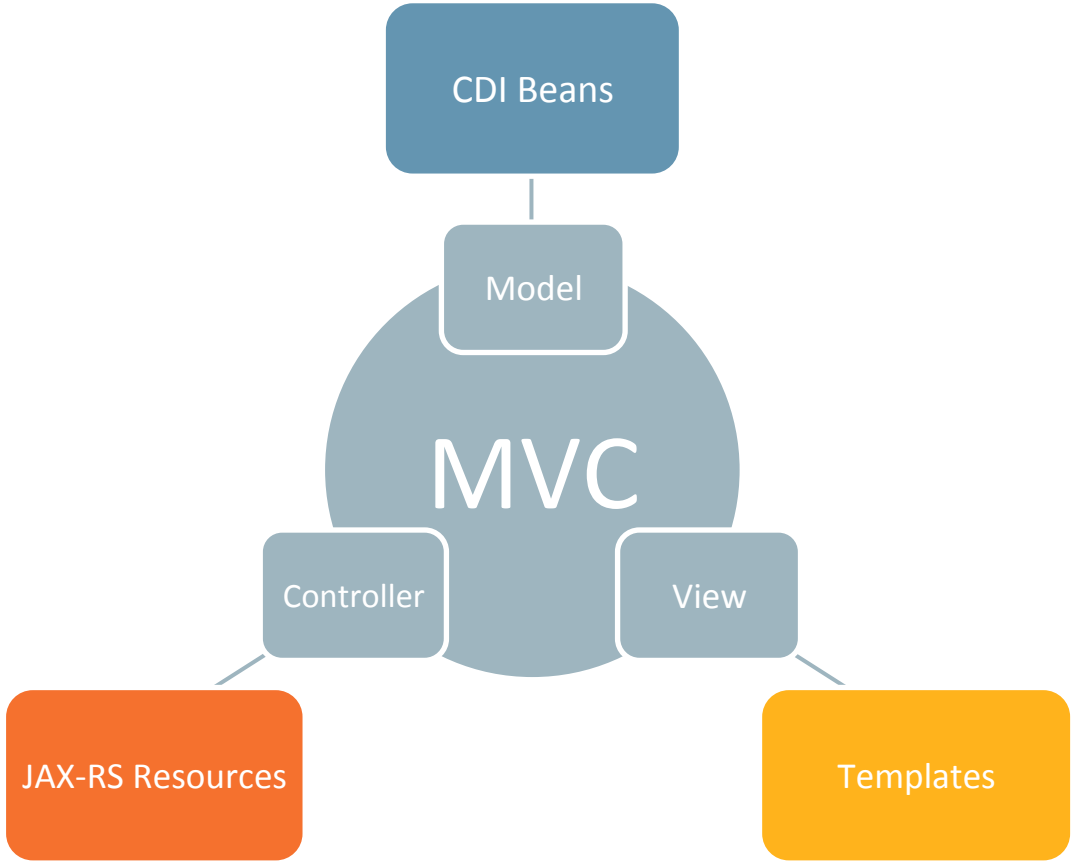
Action-Oriented



MVC and JAX-RS

- New, dedicated JSR 371 – MVC 1.0
  - Focus on action-oriented Framework
  - Leverage existing templating engines (JSP, Facelets)
  - Integrate with JAX-RS

- Model
  - Context, Injection and Bean Validation support
  - CDI Beans
- View
  - Format content based on Model data
  - Templates (JSP, Facelets, FreeMarker, Mustache, …)
- Controller
  - Dispatch model data to View templates
  - JAX-RS Resources
    - Native content-negotiation support



Jersey MVC Support

- Jersey extension modules
  - org.glassfish.jersey.ext
- Core Module (jersey-mvc)
  - View Templates
    - Producing Human-Readable Content
    - Convenient Generators for new Media Types
- Integration Modules
  - Templating Engines
    - JSP, FreeMarker, Moustache
  - BeanValidation & Error Reporting
- Minimalistic Public APIs
  - Programmatic
    - `Viewable`
  - Declarative
    - `@Template`
    - `@ErrorTemplate`

Jersey MVC Templates

```
@Path("motorcycle/{name}")
public class MotorcycleResource {

    @Inject @NotNull Catalog<Motorcycle> catalog;

    @GET @Produces(TEXT_HTML)
    @Template(name="motorcycle.jsp")
    public Motorcycle getHtml(@PathParam("name") String name) {
        return catalog.getModel(name);
    }

    @Path("parts")
    public PartsListResource getParts(@PathParam("name") String name) {
        return new PartsListResource(catalog, name);
    }
}
```

Controller

Model

View

Sub-controller

Jersey MVC Templates (contd.)

```
public class PartsListResource {

    private final String name;
    private final Catalog catalog;
    …
    @POST @Consumes(APPLICATION_JSON)
    public String addPartJson(Part part) {
        catalog.getModel(name).addPart(part);
        return “Part added.”;
    }

    @POST @Consumes(APPLICATION_FORM_URLENCODED)
    @Template(name=“confirmation.jsp”)
    public String addPartForm(@BeanParam PartFormBean bean) {
        catalog.getModel(name).addPart(bean.toPart());
        return “Part added.”;
    }
}
```

Sub-Controller

Non-browser Clients

Browser Clients View

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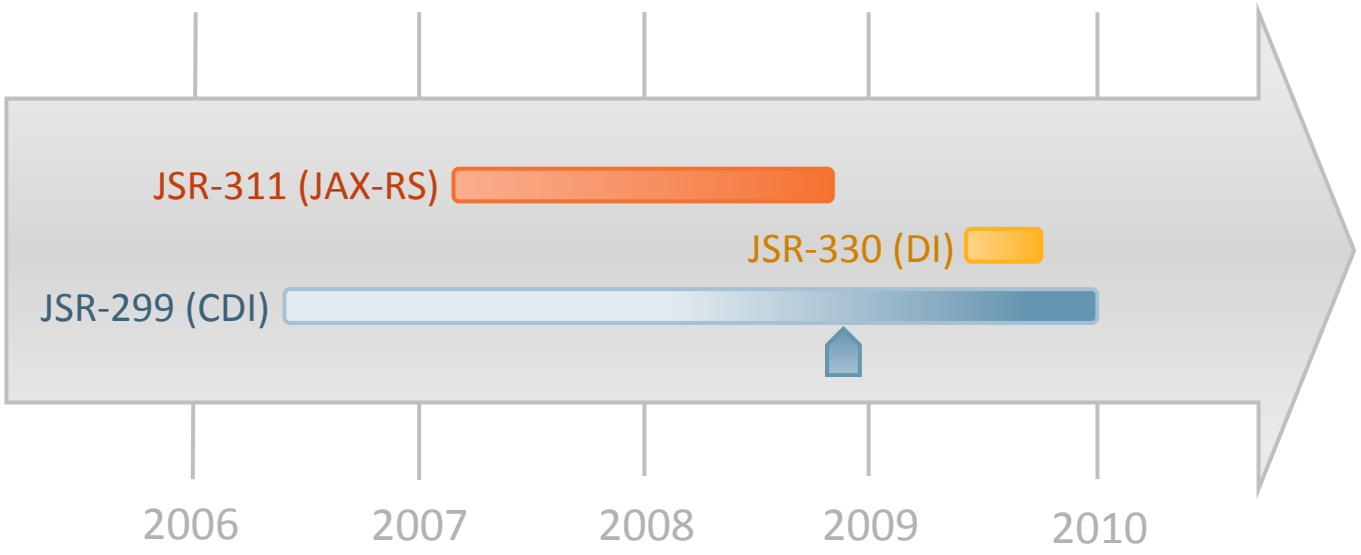
JSR-367 – Java API for JSON Binding

- API with a Feel Similar to JAXB
  - Inspired by existing popular frameworks
- Goals
  - JSON
  - Runtime API
  - Object mapping (Default | Customizable)
- Non-Goals
  - JSON Schema Support
  - Round-trip
  - Tool-time API

JAX-RS / CDI Alignment

A Road to Java EE Context & Dependency Injection



JAX-RS / CDI Alignment

- Hopeful about CDI 2.0 (JSR-365)
  - Define the behavior of CDI outside of a Java EE container
    - Also involves introducing a programmatic bootstrapping API
  - Make CDI more modular to help other Java EE specs to better integrate with it

- Main Pain Points
  - Constructor selection
  - Generic producers
    - `@PathParam("quote") String quote, @PathParam("quote") Quote quote`
  - Bootstrapping & running outside of Java EE
  - Focus on what's important (Contexts and Injection)
    - Need to reduce the footprint dramatically

Q&A