

Durable Workflows

with Effect Cluster

**THANK YOU
ORGANIZERS!**

Ego Slide

- Push buttons
- Type things
- Break stuff
- Wear sweatshirt as cape
- This picture is not stack safe

Failures along the way

```
function chargeCreditCard(cardNumber, totalAmount): Effect<void, InsufficientFundsError | PaymentGatewayError>
function createShippingTrackingCode(deliveryAddress): Effect<TrackingId, NoMoreApiCallQuotaError>
function sendConfirmationEmail(email, orderId, trackingId): Effect<void, SmtplibFailureError>

const processPayment: Effect<
  void,
  InsufficientFundsError | PaymentGateway503Error | NoMoreApiCallQuotaError | SmtplibFailureError
> = ...
```

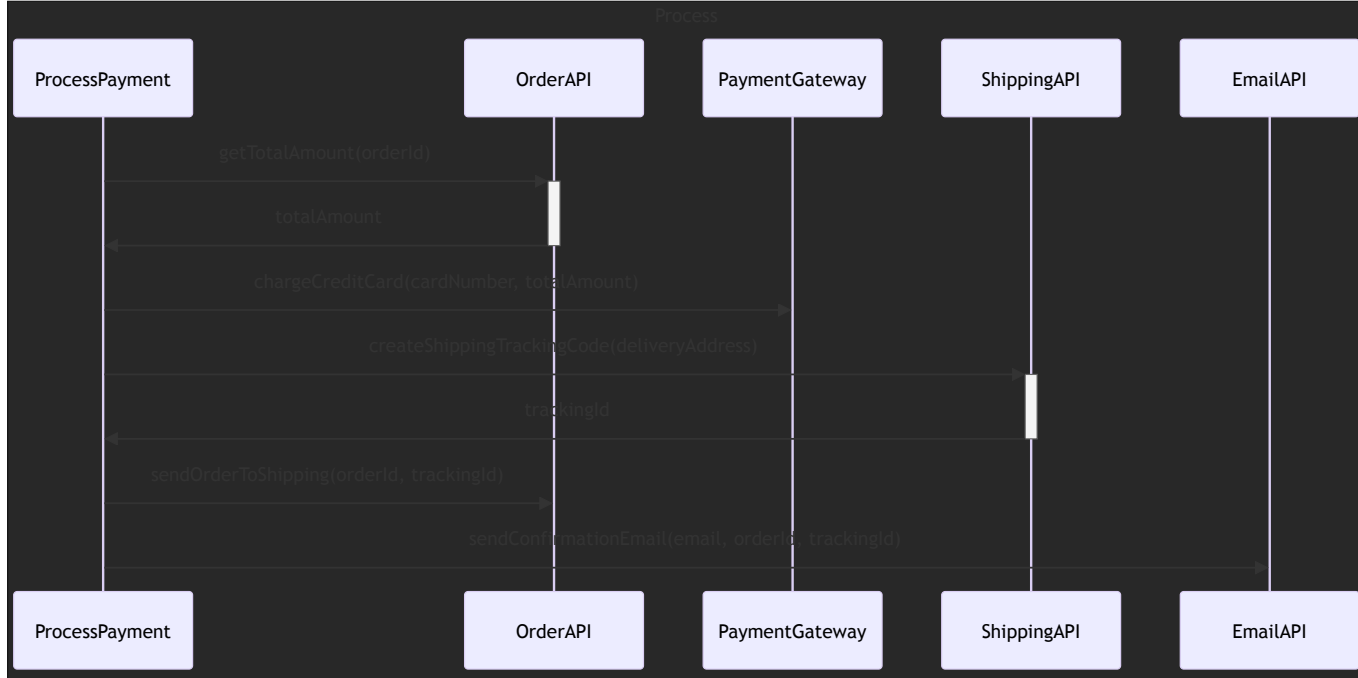
Log on failure

```
const processPayment =  
  (cardNumber: CardNumber, deliveryAddress: DeliveryAddress,  
   email: EmailAddress, orderId: OrderId) =>  
    Effect.gen(function* ($) {  
      const totalAmount = yield* $(getTotalAmount(orderId))  
      yield* $(chargeCreditCard(cardNumber, totalAmount))  
      const trackingId = yield* $(createShippingTrackingCode(deliveryAddress))  
      // ^- failure raised here!  
      yield* $(sendOrderToShipping(orderId, trackingId)) // skipped  
      yield* $(sendConfirmationEmail(email, orderId, trackingId)) // skipped  
    })
```

Retrying everything

```
const processPayment =  
  (cardNumber: CardNumber, deliveryAddress: DeliveryAddress,  
   email: EmailAddress, orderId: OrderId) =>  
    Effect.gen(function* ($) {  
      const totalAmount = yield* $(getTotalAmount(orderId))  
      yield* $(chargeCreditCard(cardNumber, totalAmount))  
      const trackingId = yield* $(createShippingTrackingCode(deliveryAddress))  
      // ^- failure raised here!  
      yield* $(sendOrderToShipping(orderId, trackingId)) // skipped  
      yield* $(sendConfirmationEmail(email, orderId, trackingId)) // skipped  
    }).pipe(  
      Effect.retry({  
        while: error => isTemporaryError(error)  
      })  
    )
```

Business Process



Transactions?

```
BEGIN TRANSACTION;  
UPDATE card_balances SET balance = balance - 10 WHERE card_number = 42  
UPDATE orders SET tracking_id = 'abc' WHERE order_id = 12  
COMMIT TRANSACTION;
```

Distributed systems are everywhere

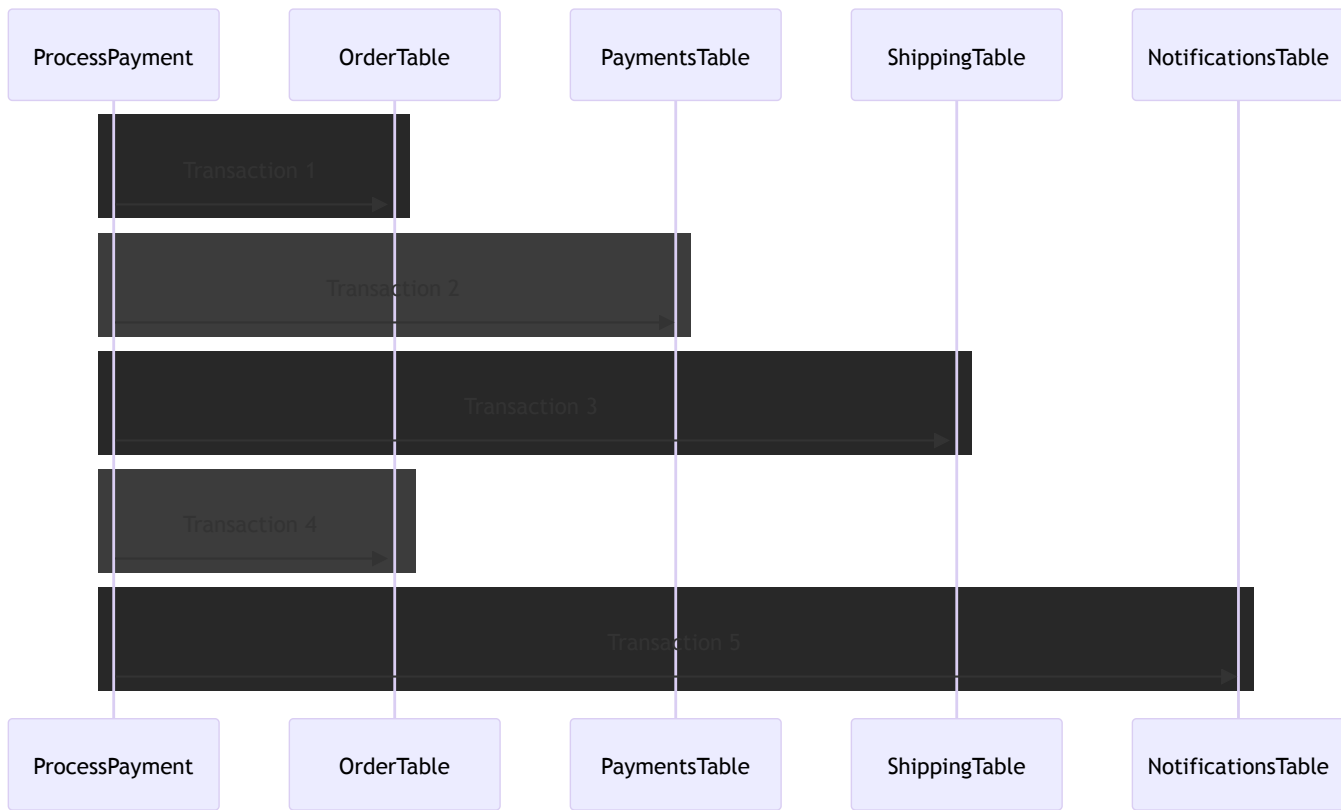
Distributed Workflows are everywhere

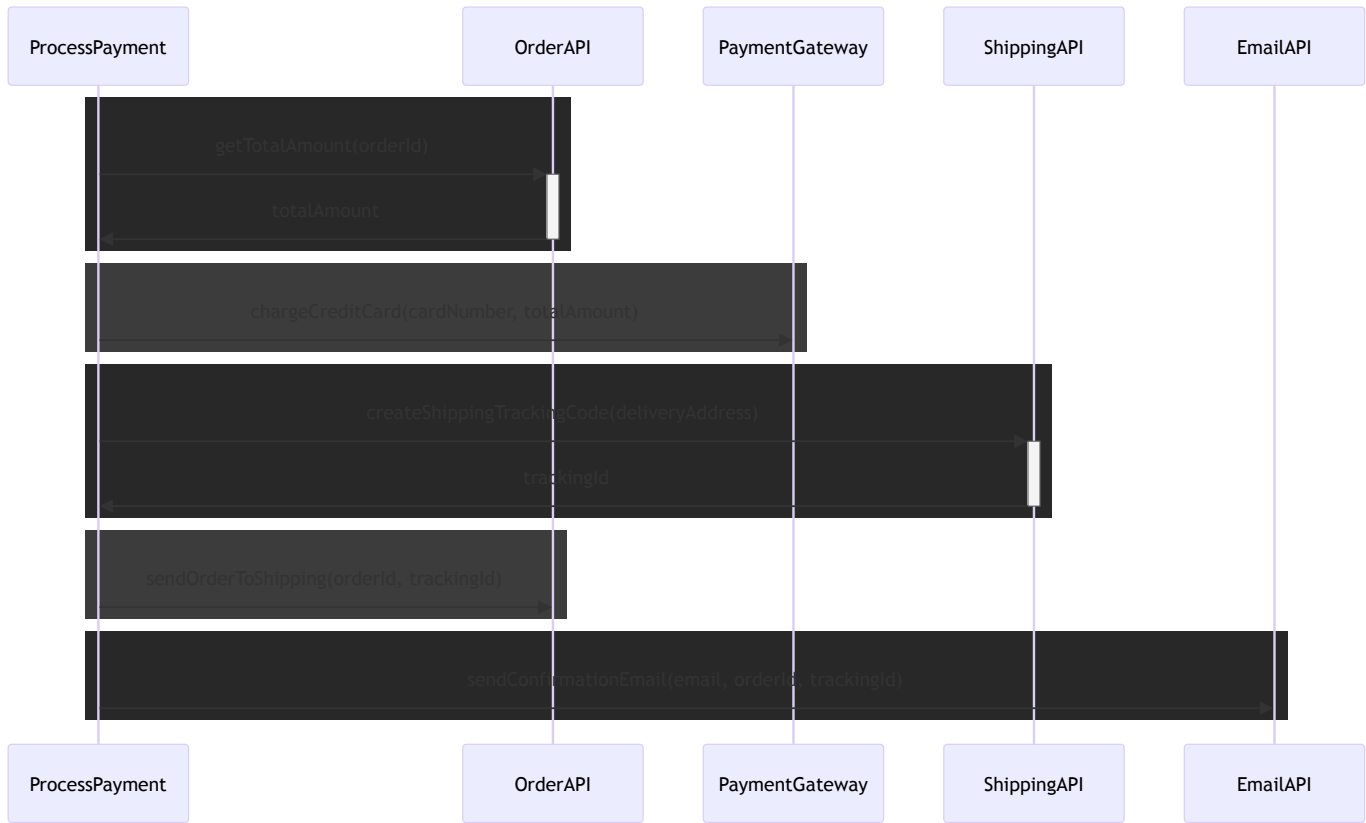
Welcome Effect Cluster

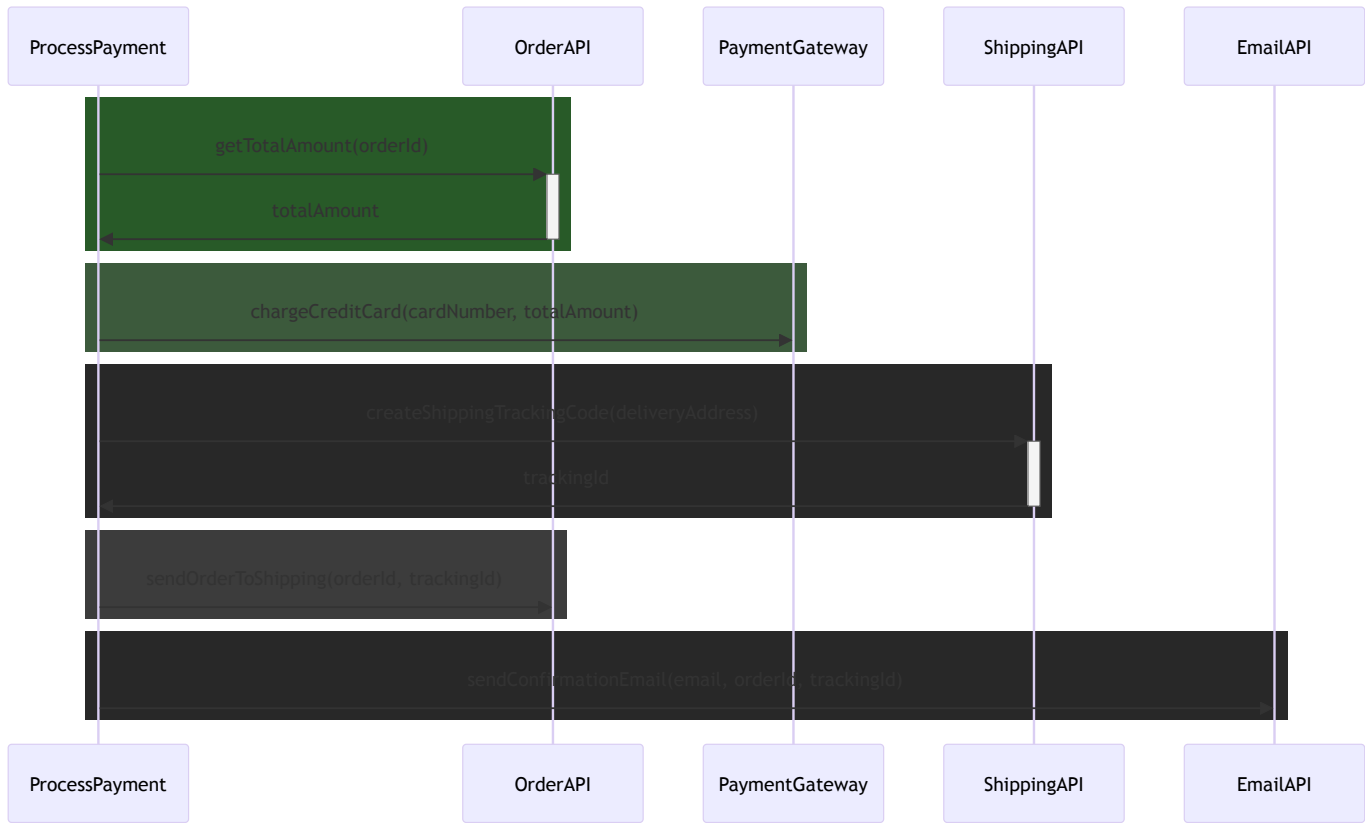
All the building blocks you need to deal with distributed workflows with ease!

...long lived
transactions?

- Sagas!
- in 1987 they had computers!







Defining an activity

- Work unit of a Workflow
- Can interact with external systems
- Executes an Effect
- Uniquely identified inside Workflow
- Requires schemas for success and failure

```
const getTotalAmount = (id: string) =>
  Activity.make(
    `get-amount-due-${id}`, // identifier
    Schema.number, // success schema
    Schema.struct({ code: Schema.number,
      message: Schema.string }) // error schema
  )(
    pipe(
      Http.request.get(`/get-total-amount/${id}`)
      Http.client.fetchOk(),
      Effect.andThen((response) => response.json),
      Effect.mapError(() => ({
        code: 500,
        message: `API Fetch error`
      }))
    )
  )
)
```

Defining a workflow

- Is started by a Request
- Requires schemas for success and failure
- Has a payload of information

```
class ProcessPaymentRequest extends
  Schema.TaggedRequest<ProcessPaymentRequest>()(
    `ProcessPaymentRequest`, // tag
    Schema.never, // failure
    Schema.boolean, // success
  {
    orderId: Schema.string,
    cardNumber: Schema.string,
    email: Schema.string,
    deliveryAddress: Schema.string
  }
) {
}
```

Defining a workflow

```
const processPaymentWorkflow = Workflow.make(  
  ProcessPaymentRequest,  
  (_) => `ProcessPayment@${_.orderId}`,  
  ({ cardNumber, deliveryAddress, email, orderId }) =>  
    Effect.gen(function* ($) {  
      const totalAmount = yield* $(getTotalAmount(orderId))  
      yield* $(chargeCreditCard(cardNumber, totalAmount))  
      const trackingId = yield* $(createShippingTrackingCode(deliveryAddress))  
      yield* $(sendOrderToShipping(orderId, trackingId))  
      yield* $(sendConfirmationEmail(email, orderId, trackingId))  
    })  
)
```

- Coordinator of activities
- Durable execution
- Requires deterministic code

WTF is deterministic?

Given a set of input, the output of the function must be always the same and predictable, without triggering any side effects that may later affect the computation.

Deterministic

- Math & Logic ops
- Seed based random

Non-Deterministic

- `Math.random()`
- `new Date()`
- R/W Global Shared State (also DB)

Determinism & Workflows

```
const processPaymentWorkflow = Workflow.make(  
  ProcessPaymentRequest,  
  (_) => "ProcessPayment@" + _.orderId,  
  ({ cardNumber, deliveryAddress, email, orderId }) =>  
    Effect.gen(function* ($) {  
      const totalAmount = yield* $(Effect.succeed(42.1) /* getTotalAmount(orderId) */)   
      yield* $(Effect.unit /* chargeCreditCard(cardNumber, totalAmount) */)   
      const trackingId = yield* $(createShippingTrackingCode(deliveryAddress))   
      yield* $(sendOrderToShipping(orderId, trackingId))   
      yield* $(sendConfirmationEmail(email, orderId, trackingId))   
    })  
)
```

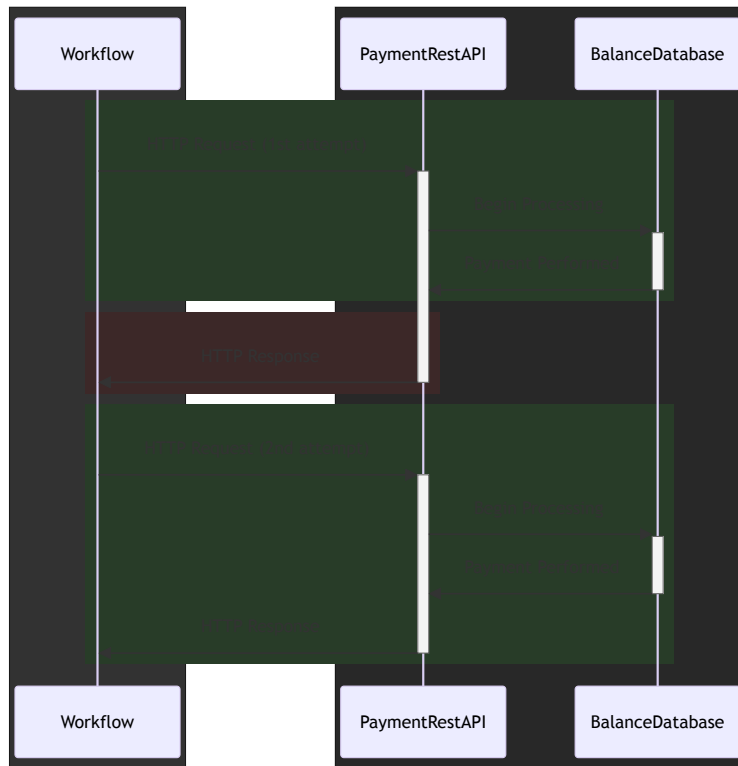
Running a Workflow

```
const main = Effect.gen(function*($) {  
  const workflows = Workflow.union(processPaymentWorkflow, requestRefundWorkflow)  
  const engine = yield* $(WorkflowEngine.makeScoped(workflows))  
  yield* $(  
    engine.sendDiscard(  
      new ProcessPaymentRequest({  
        orderId: "order-1",  
        cardNumber: "my-card",  
        deliveryAddress: "My address, 5, Italy",  
        email: "my@email.com"  
      })  
    )  
  )  
})  
runMain(  
  pipe(  
    main,  
    Effect.provide(DurableExecutionJournalPostgres.DurableExecutionJournalPostgres)  
  )  
)
```

**Activity is a
Black Box**

The double-payment problem

- Any transport may fail
- Not getting a response does not mean it has not been processed

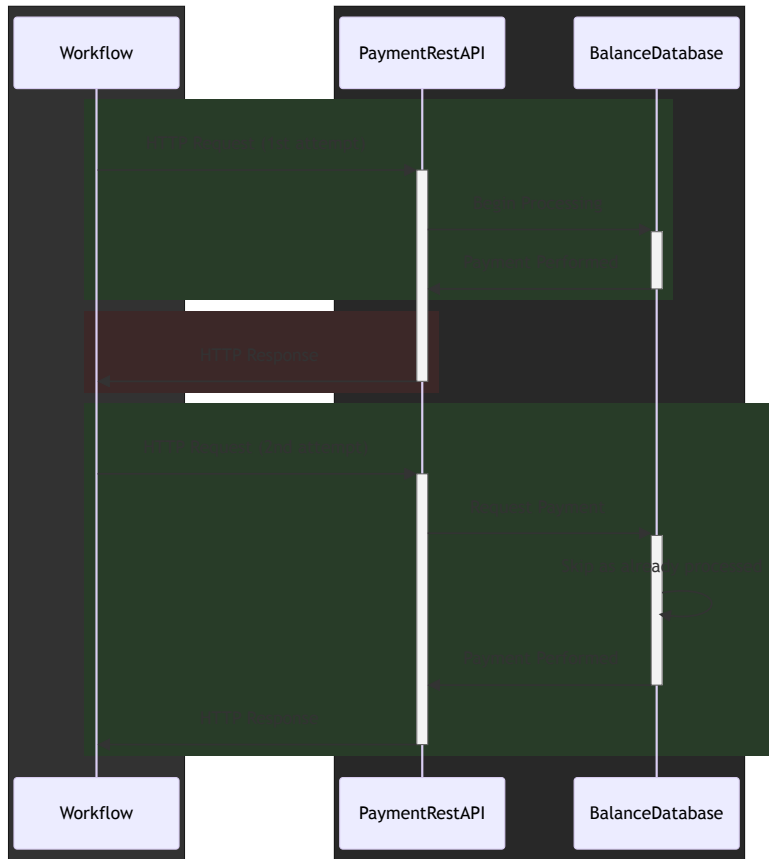


Idempotency

Multiple invocation of the same function, result on a state change as they were executed only the first time.

Idempotence using IDs

```
const chargeCreditCard =  
  (cardNumber: string, amountDue: number) =>  
    pipe(  
      Activity.persistenceId,  
      Effect.flatMap(  
        (persistenceId) => callPaymentGateway(  
          persistenceId,  
          cardNumber,  
          amountDue  
        )  
      ),  
      Activity.make(  
        "charge-credit-card",  
        Schema.void,  
        Schema.never  
      )  
    )  
  )
```



Yielding workflow execution

```
const getTotalAmount = (id: string) =>
  pipe(
    Http.request.get(`/get-total-amount/${id}`)
    .pipe(
      Http.client.fetchOk(),
      Effect.andThen((response) => response.json),
      Effect.retry(
        Schedule.exponential(1000).pipe(
          Schedule.compose(Schedule.recurs(32)),
        ),
      ),
    ),
    Effect.catchAllCause(() => pipe(
      Effect.logError("Something is wrong with the OrderAPI right now"),
      Effect.zipRight(Workflow.yieldExecution)
    ))
  ),
  Activity.make(`get-amount-due-${id}`, Schema.number, Schema.never)
)
```

Fixing workflows

```
const processPaymentWorkflow = Workflow.make(
  ProcessPaymentRequest,
  (_) => `ProcessPayment@${_.orderId}`,
  ({ cardNumber, deliveryAddress, email, orderId }) =>
    Effect.gen(function* ($) {
      const version = yield* $(getCurrentVersion(2))
      // ^- for already running WFs, will resolve with previous value (1)
      // ...
      if(version ≥ 2){
        yield* $(checkTrustedCardNumber(cardNumber))
      }
      yield* $(chargeCreditCard(cardNumber, totalAmount))
      // ...
    })
)

const getCurrentVersion = (definitionVersion: number) => pipe(
  Effect.succeed(definitionVersion),
  Activity.make("get-current-version", Schema.number, Schema.void)
)
```

All or Nothing

Compensating actions

```
const processPaymentWorkflow = Workflow.make(
  ProcessPaymentRequest,
  (_) => `ProcessPayment@${_.orderId}`,
  ({ cardNumber, deliveryAddress, email, orderId }) =>
    pipe(
      getTotalAmount(orderId),
      Effect.flatMap(totalAmount => pipe(
        chargeCreditCard(cardNumber, totalAmount),
        Effect.flatMap(() => createShippingTrackingCode(deliveryAddress)),
        Effect.tap(trackingId => sendOrderToShipping(orderId, trackingId)),
        Effect.tap(trackingId => sendConfirmationEmail(email, orderId, trackingId)),
        Effect.catchTag("OutOfStockError", () => refundCreditCard(cardNumber, totalAmount))
      ))
    )
)
```

Effect Cluster Workflows

Building durable and reliable Effects for your applications

Effect Cluster Sharding and Location Transparency

Safely distribute work and refer to entity without knowing their location


```
import * as RecipientType from "@effect/cluster/RecipientType"
import * as Schema from "@effect/schema/Schema"

export class Increment extends Schema.TaggedClass<Increment>()("Increment", {
  messageId: Schema.string
}) {}

export class Decrement extends Schema.TaggedClass<Decrement>()("Decrement", {
  messageId: Schema.string
}) {}

export class GetCurrent extends
  Schema.TaggedRequest<GetCurrent>()("GetCurrent", Schema.never, Schema.number, {
    messageId: Schema.string
  }) {}

export const CounterMsg = Schema.union(Increment, Decrement, GetCurrent)
export type CounterMsg = Schema.Schema.To<typeof CounterMsg>

export const CounterEntity = RecipientType.makeEntityType("Counter", CounterMsg, (_) => _.messageId)
```

```

Sharding.registerEntity(
  CounterEntity
)(
  RecipientBehaviour.fromFunctionEffectStateful(
    () => Effect.succeed(0),
    (_, message, stateRef) => {
      switch (message._tag) {
        case "Increment":
          return pipe(Ref.update(stateRef, (count) => count + 1), Effect.as(MessageState.Processed(Option.some(count))))
        case "Decrement":
          return pipe(Ref.update(stateRef, (count) => count - 1), Effect.as(MessageState.Processed(Option.some(count))))
        case "GetCurrent":
          return pipe(
            Ref.get(stateRef),
            Effect.exit,
            Effect.map((result) => MessageState.Processed(Option.some(result)))
          )
      }
    }
  )
)

```

Today's Recap

Effect cluster provides all the basic building blocks you'll need to build distributed workflows and systems

`@effect/cluster`

- Sharding
- Shard Manager
- Messaging utilities

`@effect/cluster-node`

- Cluster specific utilities for NodeJS

`@effect/cluster-workflow`

- Activity
- Workflow
- WorkflowEngine

`@effect/cluster-pg`

- Postgres based persistency for Workflow and Sharding

Happy Effect-ing!

Thanks for your time!