Acceptance Testing for Continuous Delivery

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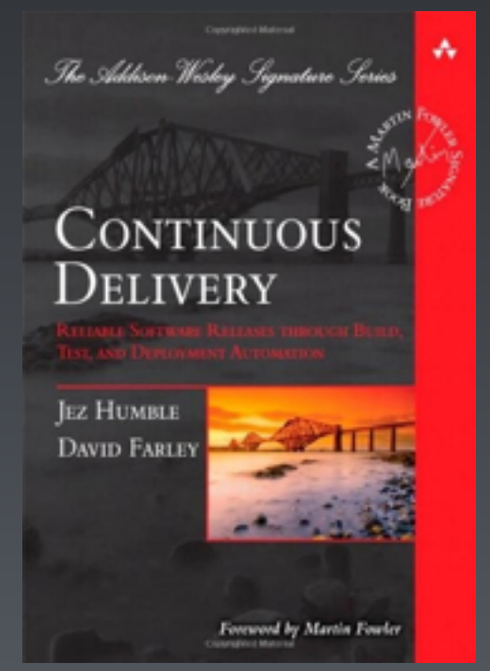

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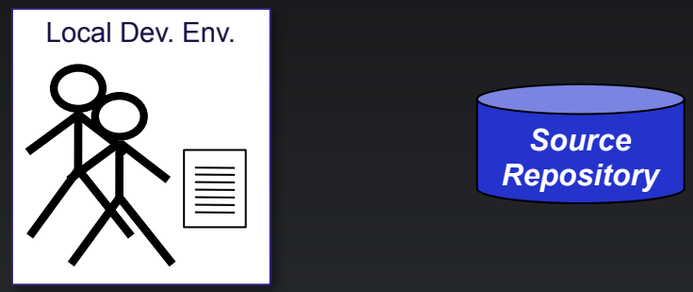
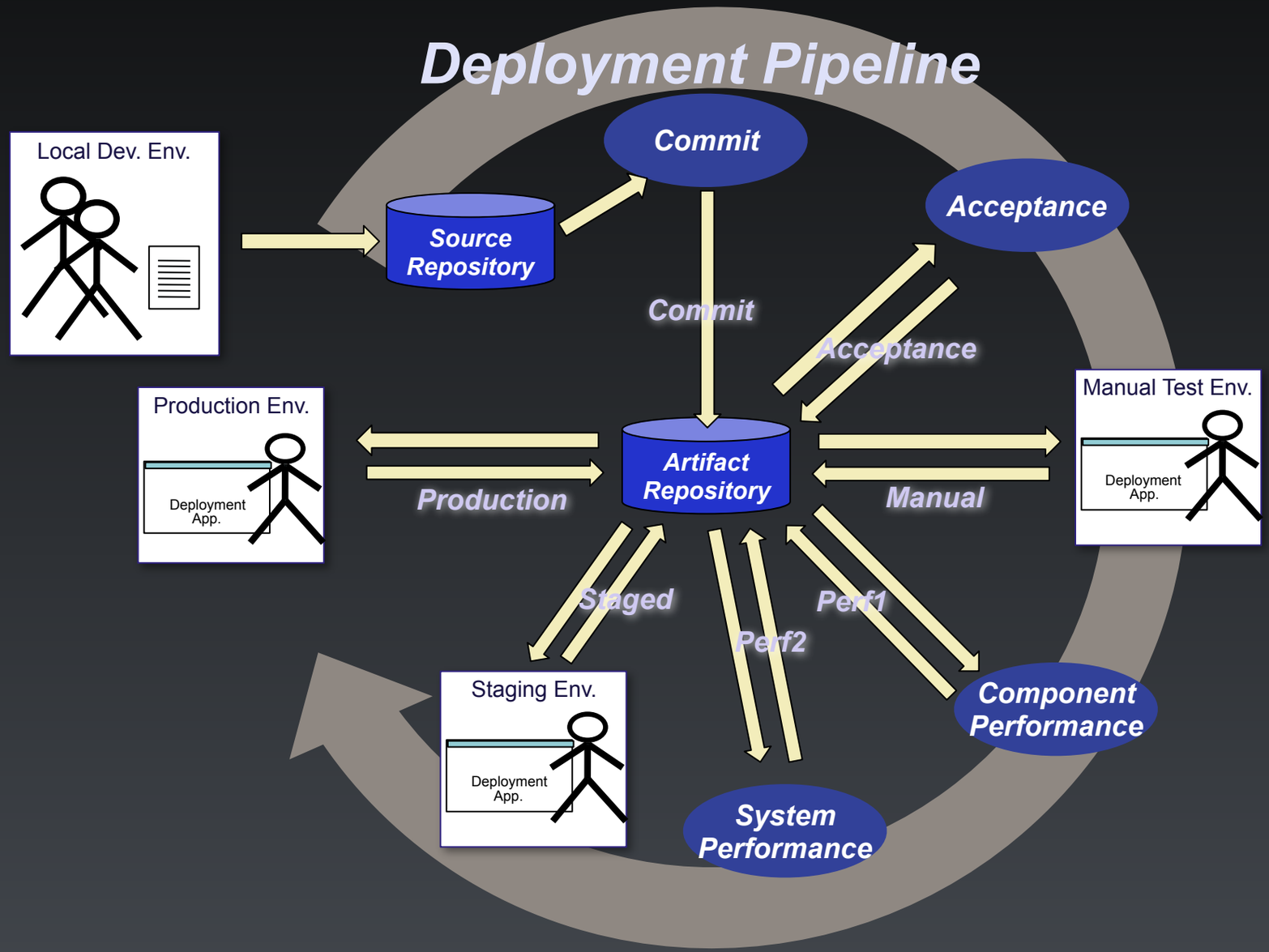
The Role of Acceptance Testing



The Role of Acceptance Testing



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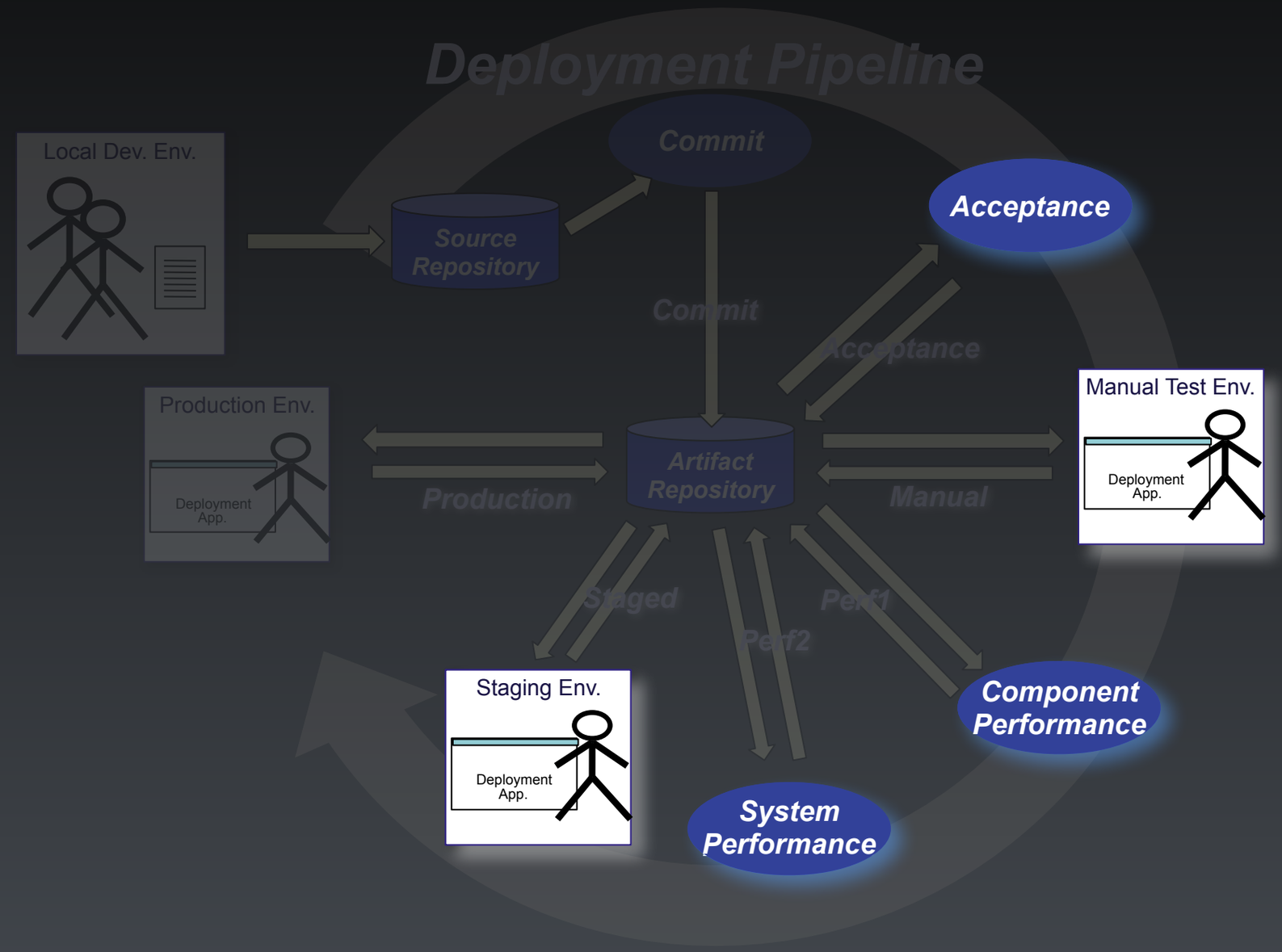

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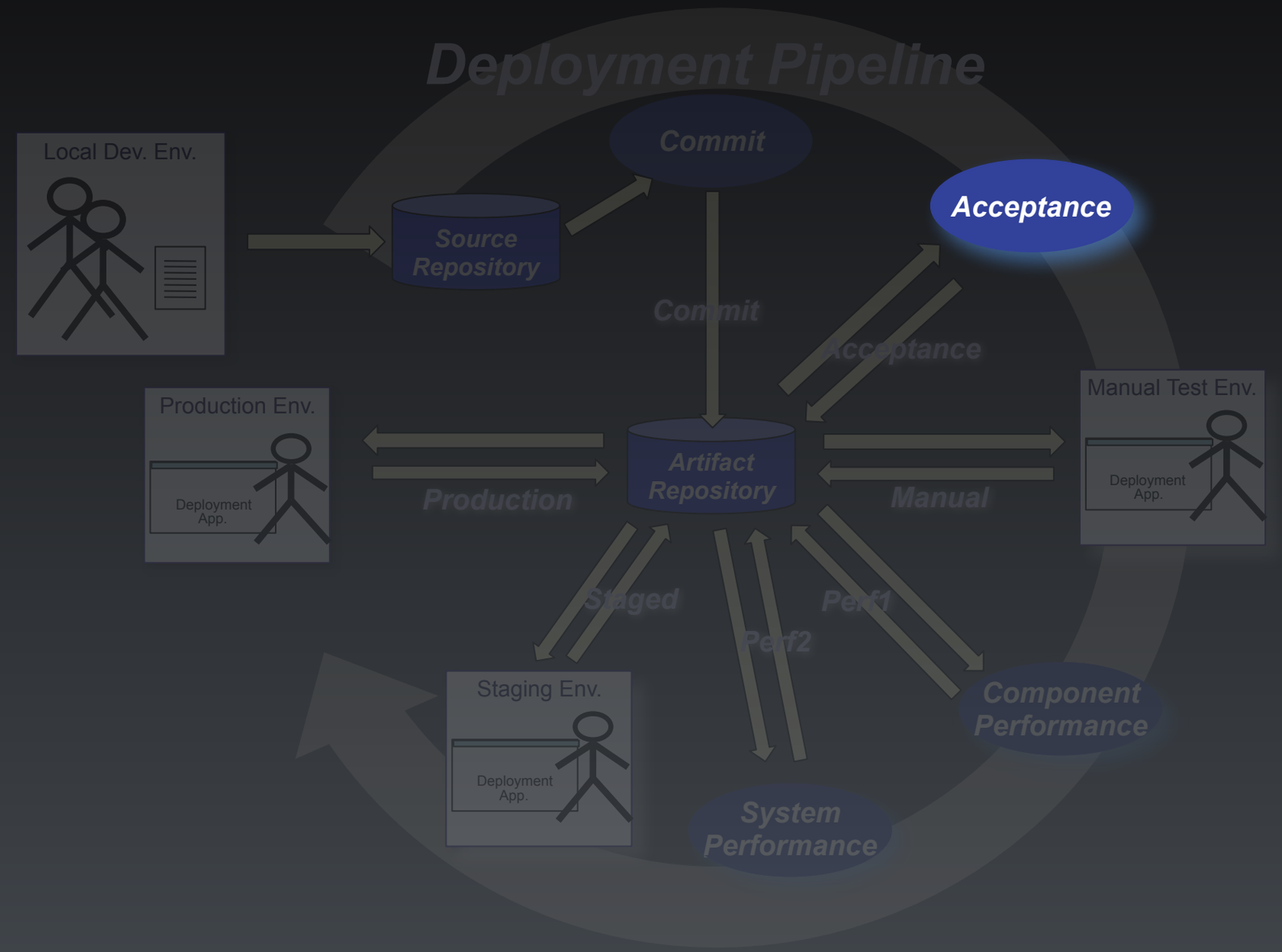

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What is Acceptance Testing?

- Asserts that the code does what the users want.
- An automated “definition of done”
- Asserts that the code works in a “production-like” test environment.
- A test of the deployment and configuration of a whole system.
- Provides timely feedback on stories - closes a feedback loop.
- Acceptance Testing, ATDD, BDD, Specification by Example, Executable Specifications.

What is Acceptance Testing?

A Good Acceptance Test is:

An Executable Specification of the Behaviour of the System

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What is Acceptance Testing?

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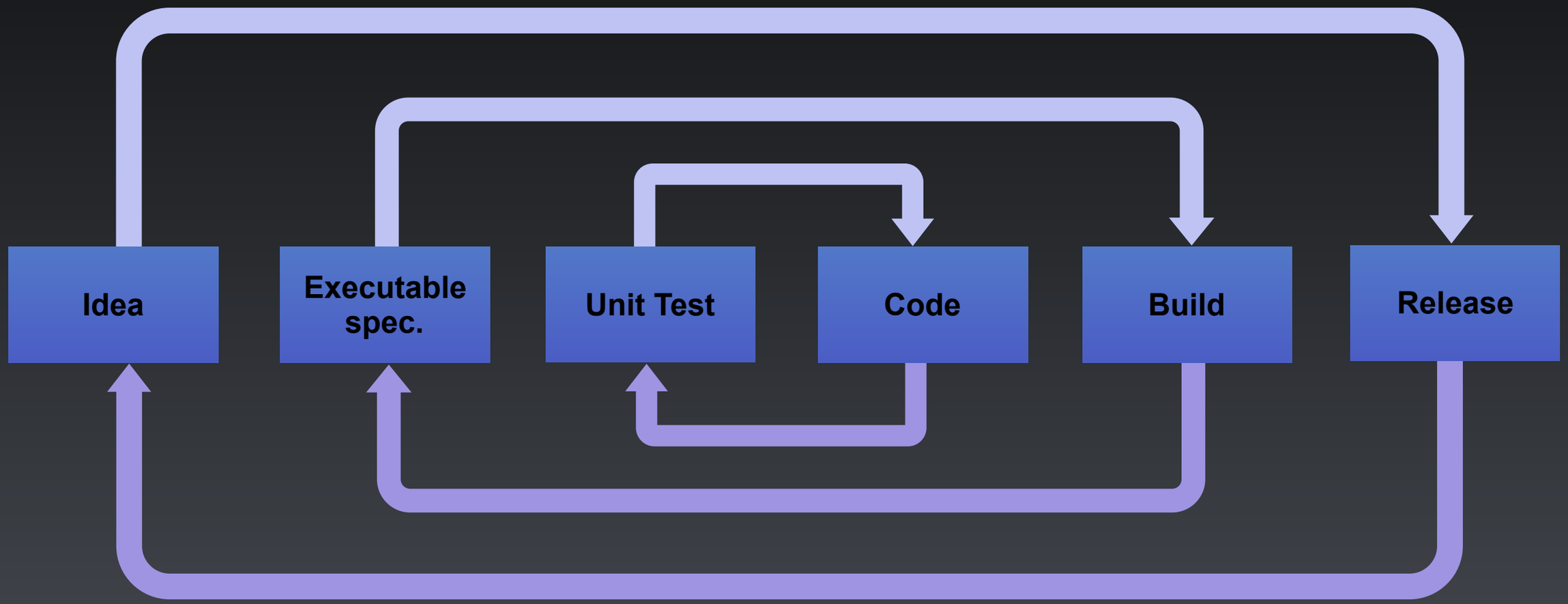

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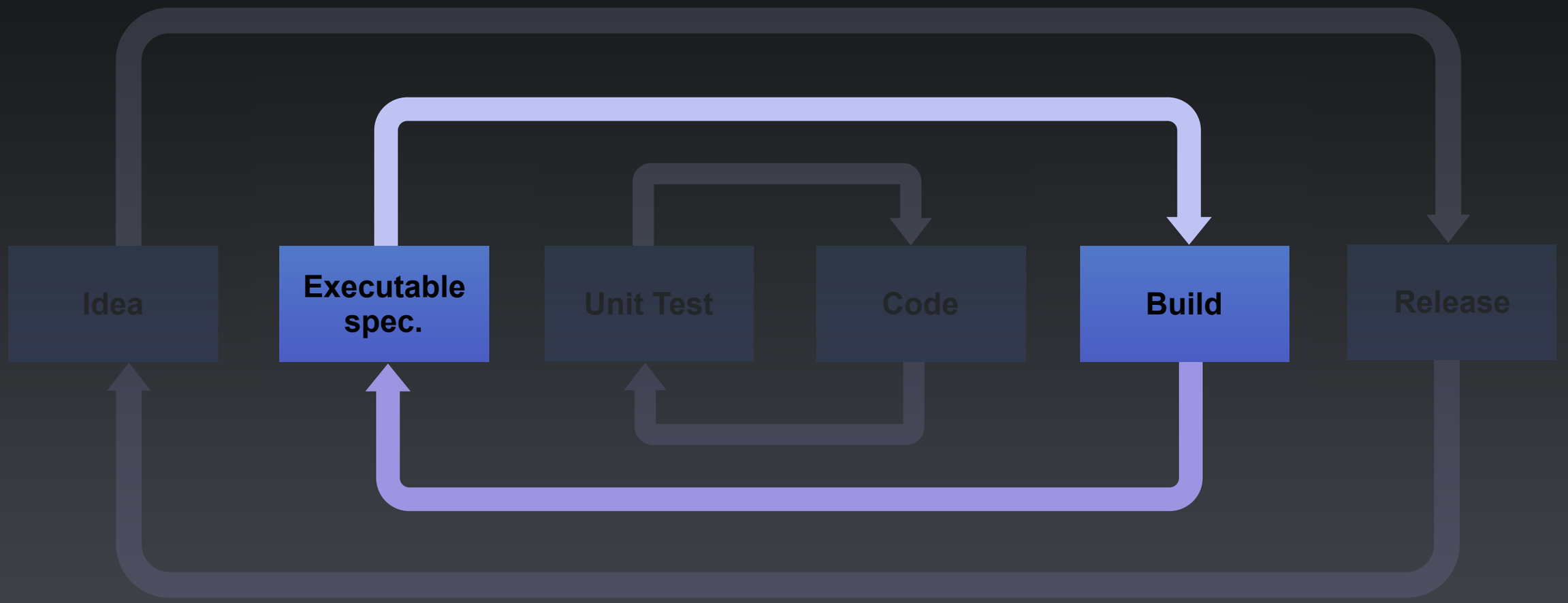

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So What's So Hard?

- Tests break when the SUT changes (Particularly UI)
- Tests are complex to develop
- This is a problem of design, the tests are too tightly-coupled to the SUT!
- The history is littered with poor implementations:
  - UI Record-and-playback Systems
  - Record-and-playback of production data
  - Dumps of production data to test systems
  - Nasty automated testing products.

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Who Owns the Tests?

Developers Own Acceptance Tests!

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Properties of Good Acceptance Tests

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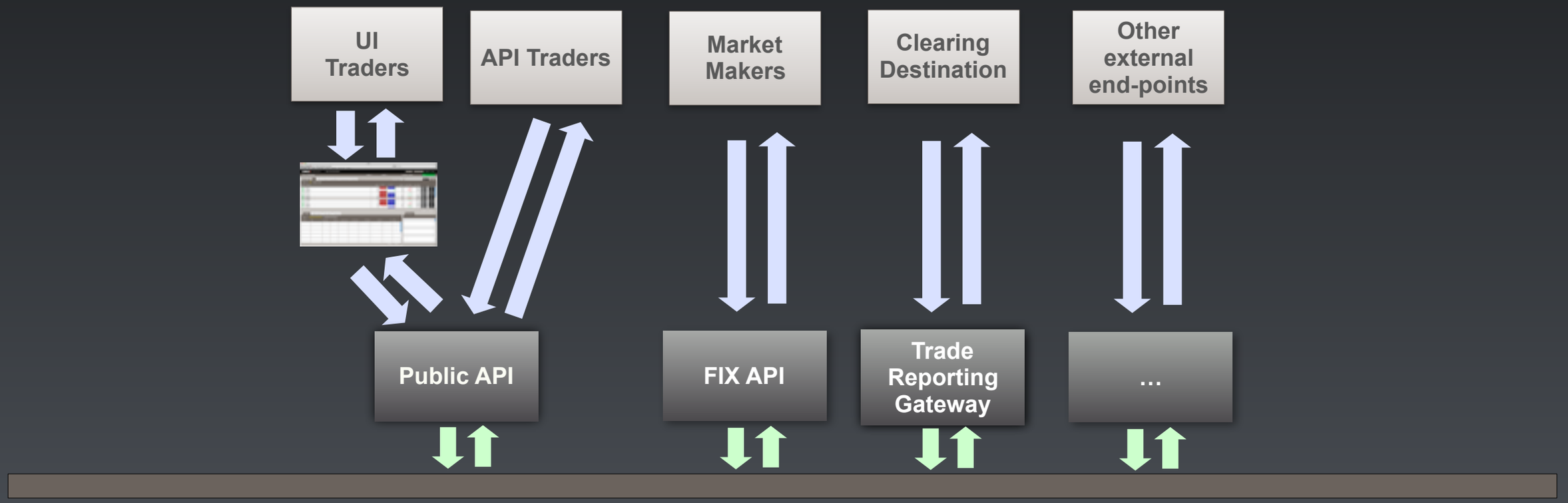

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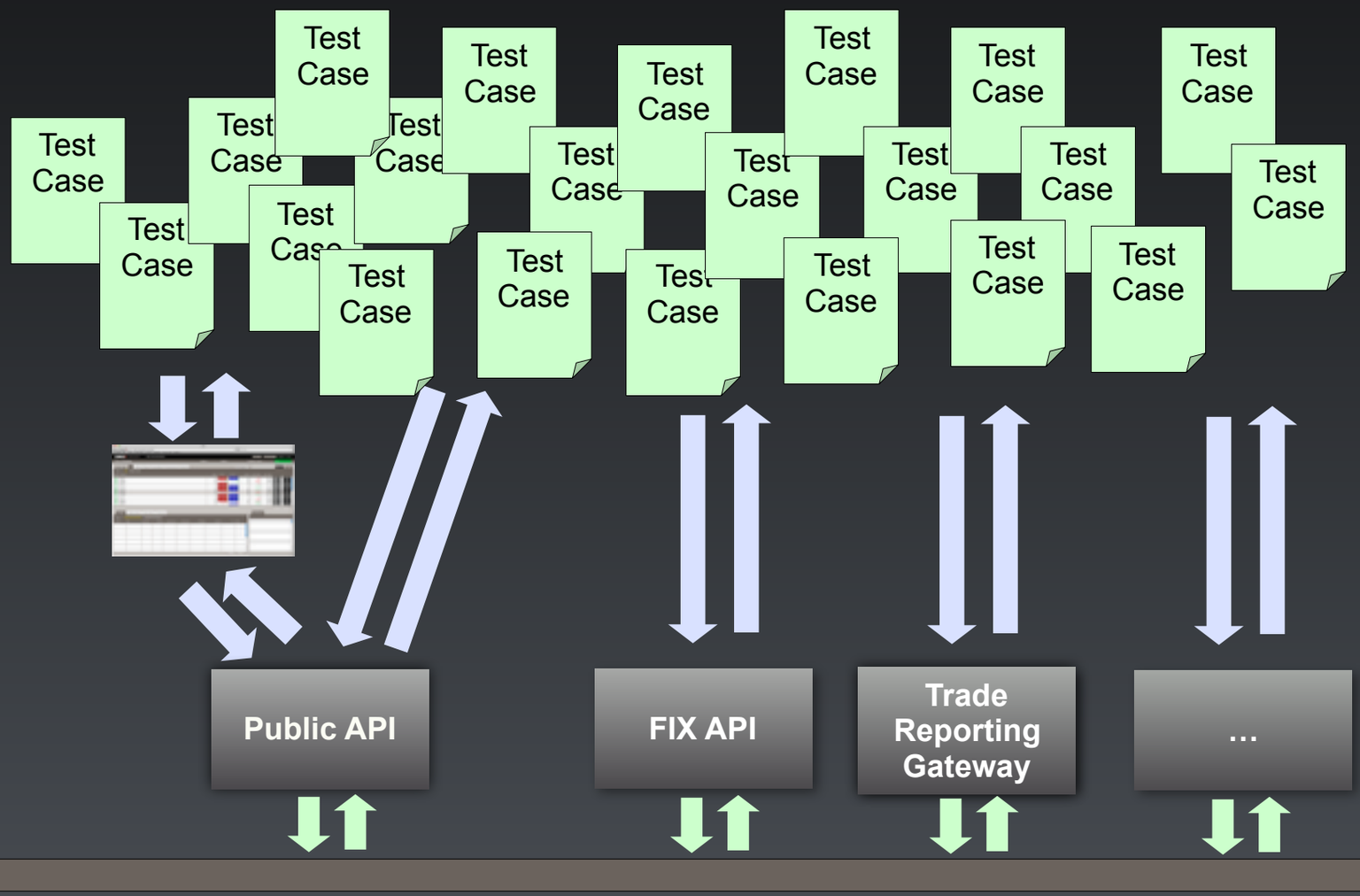

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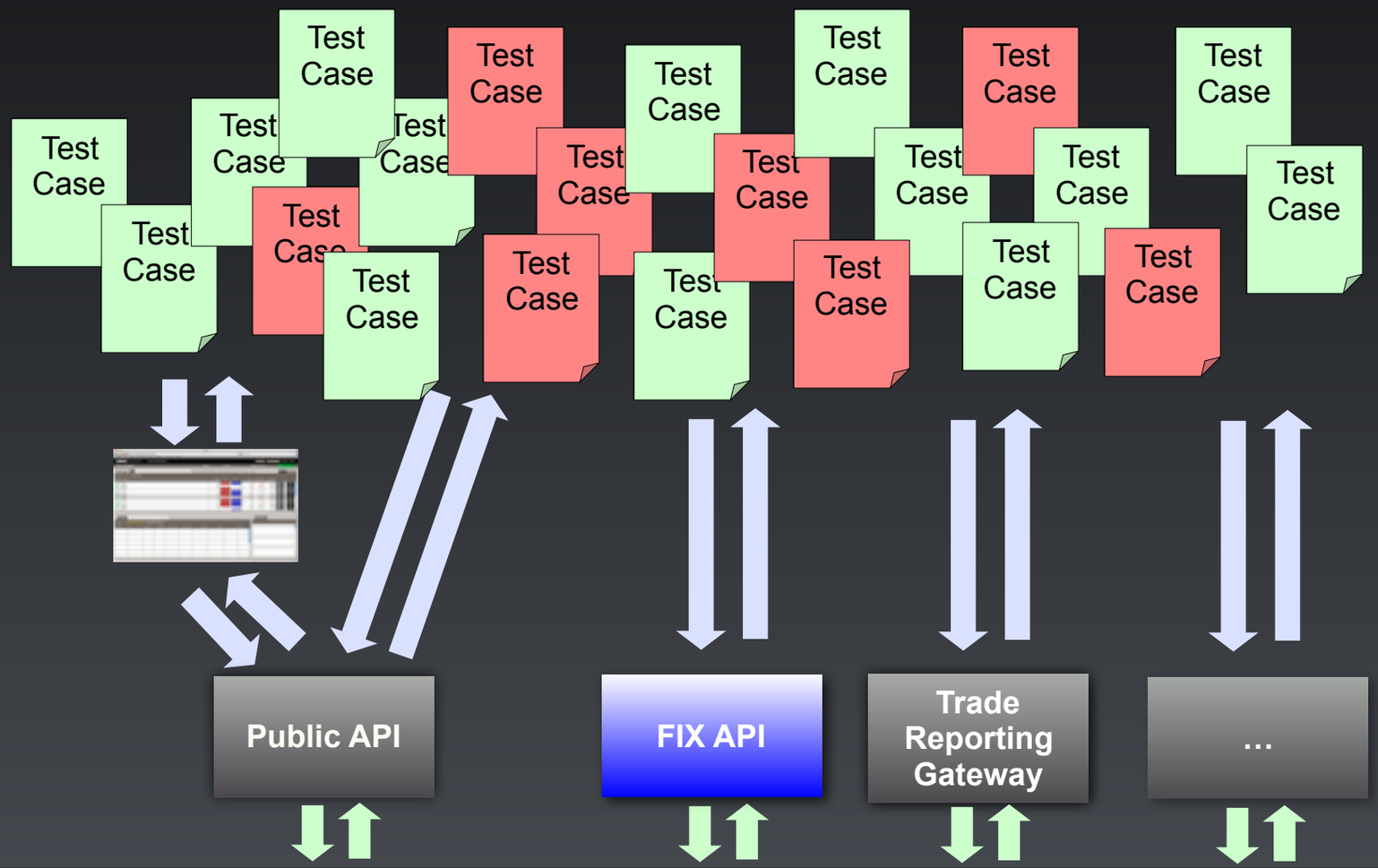

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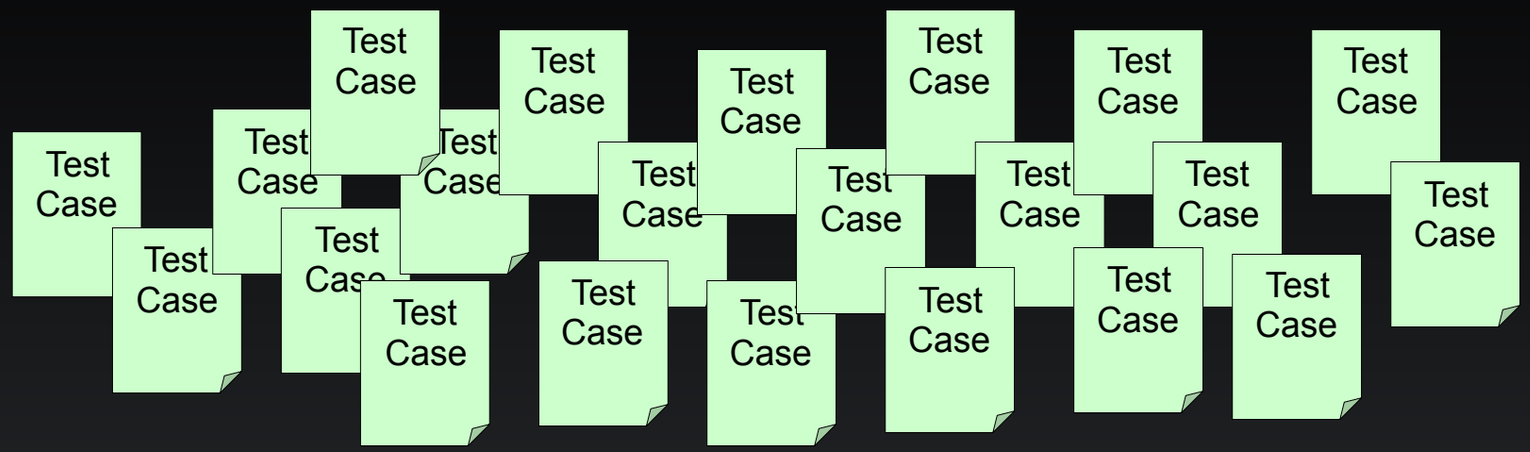

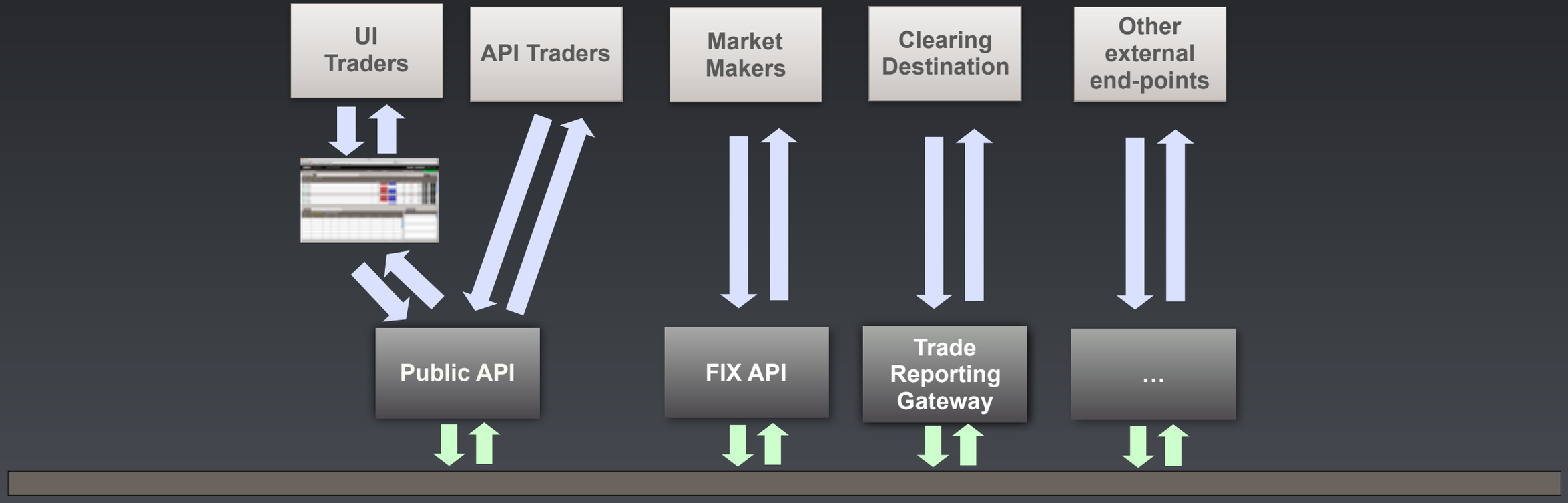

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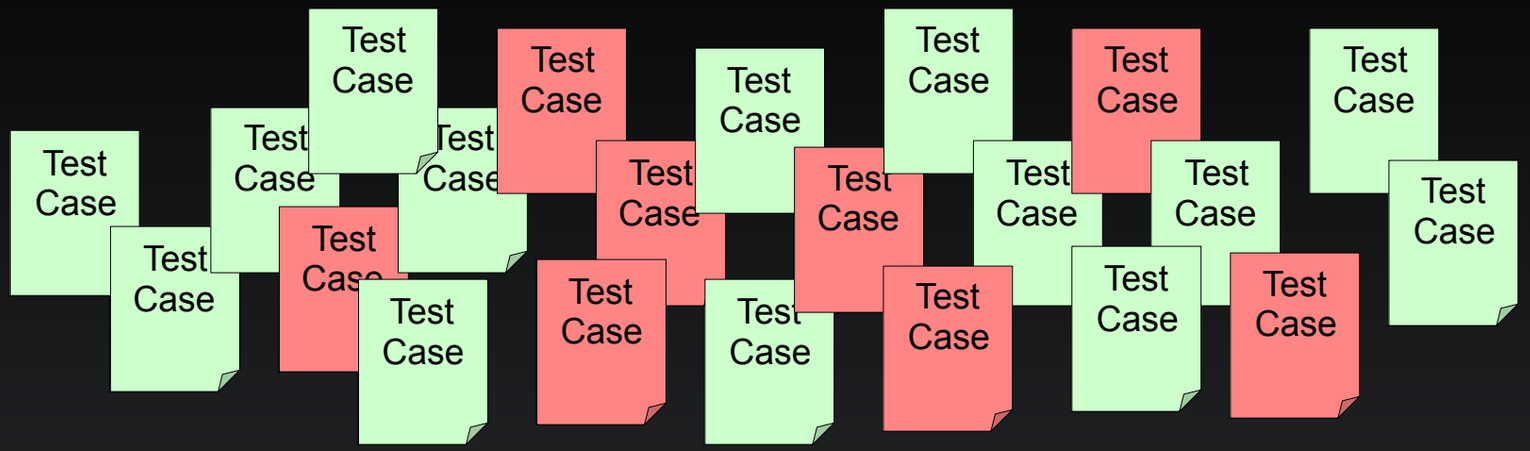

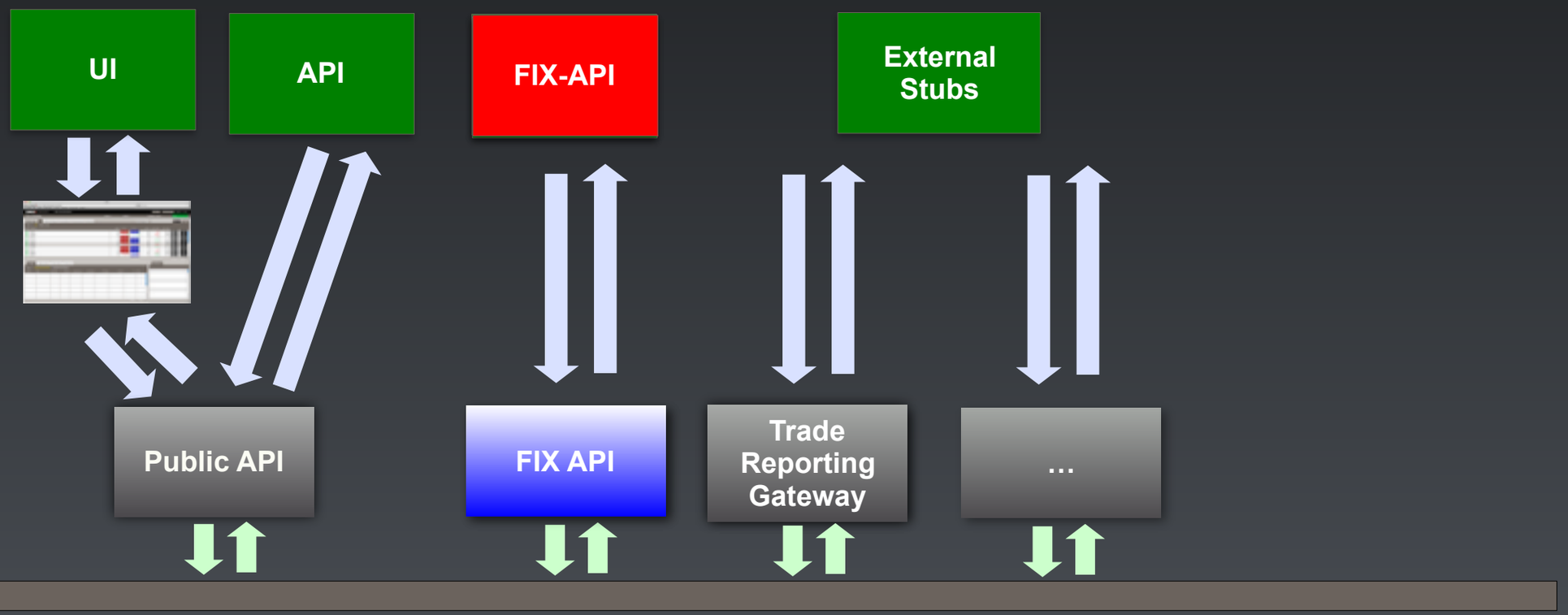

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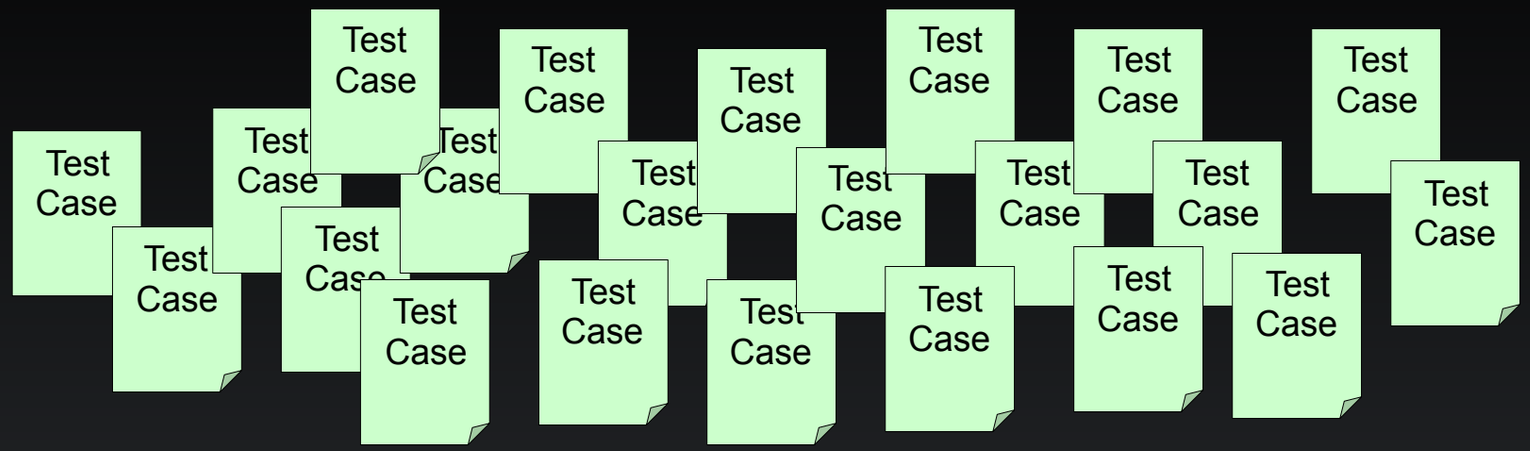

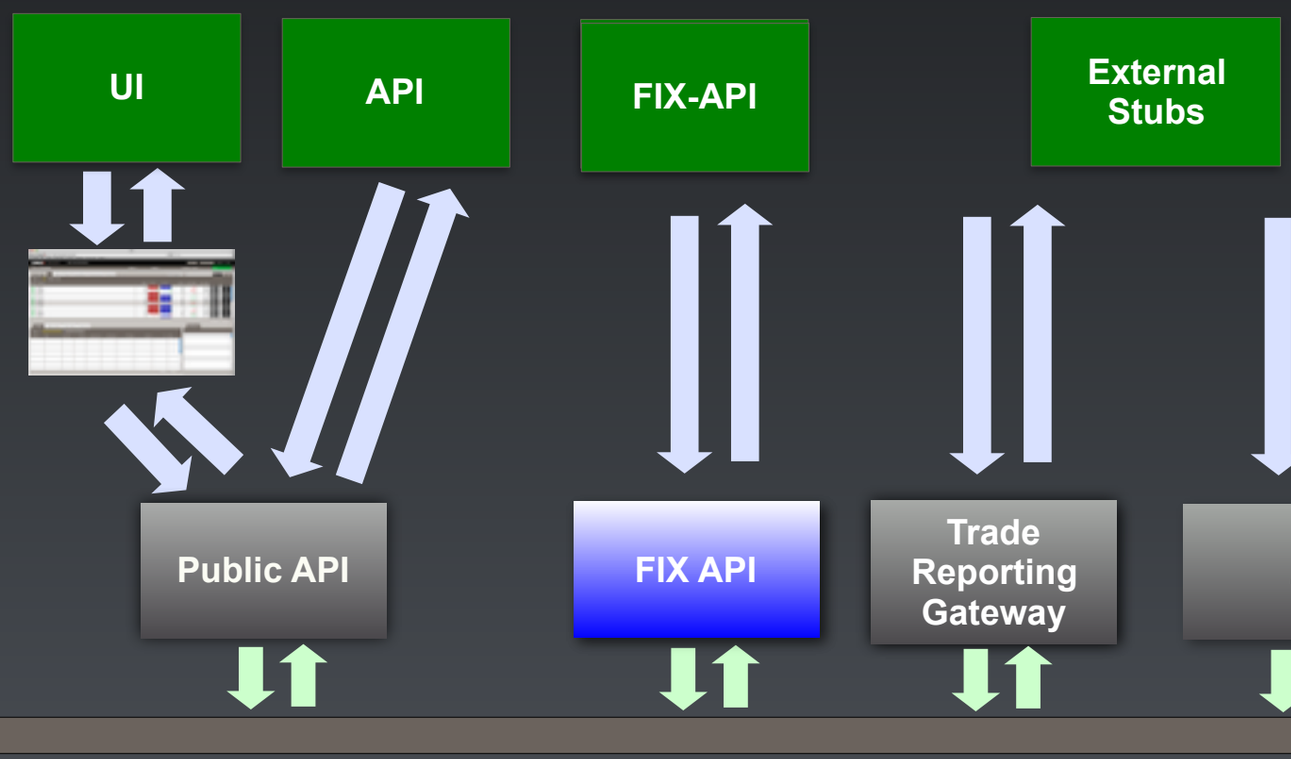

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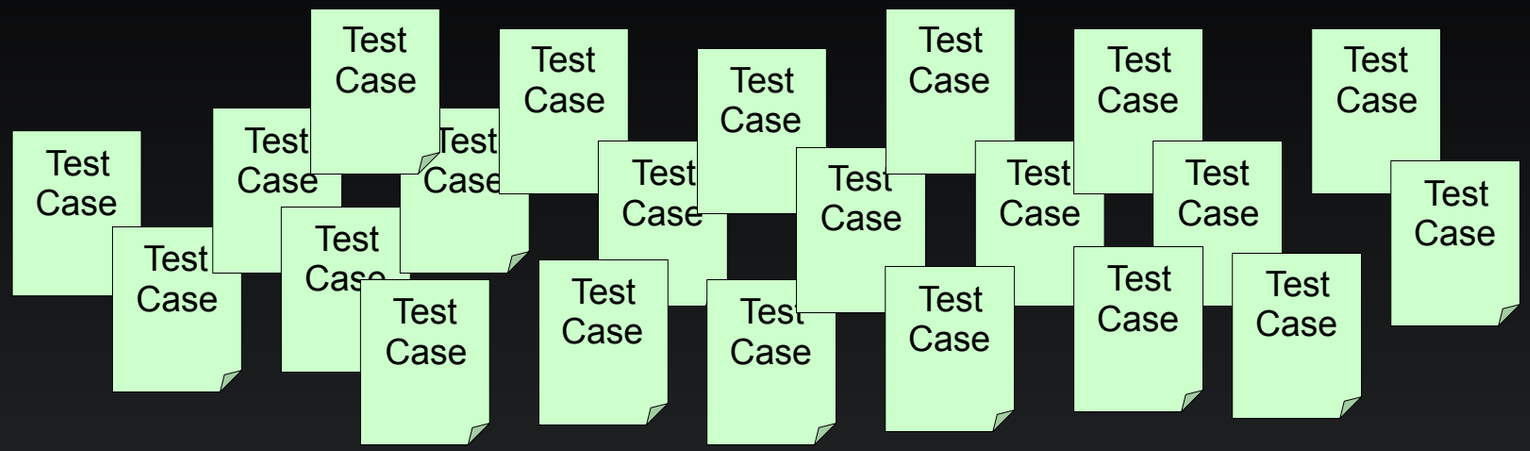

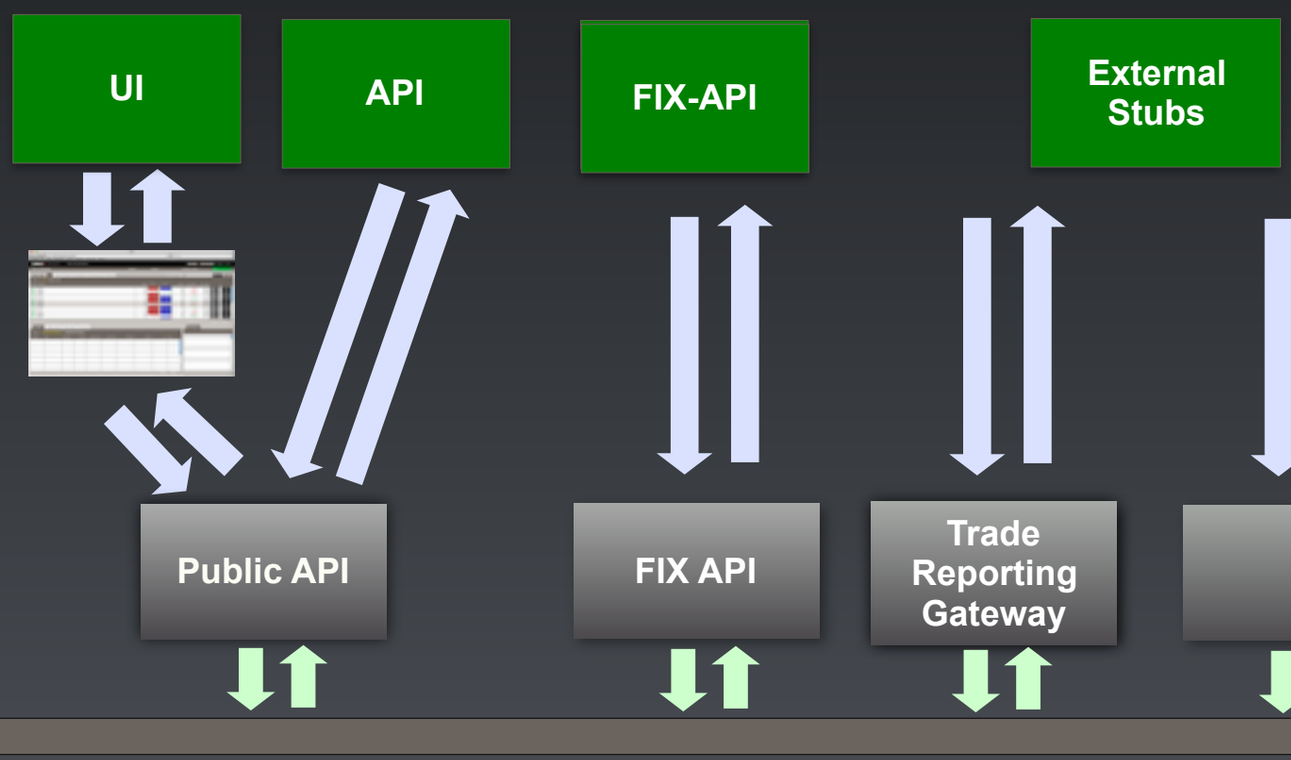

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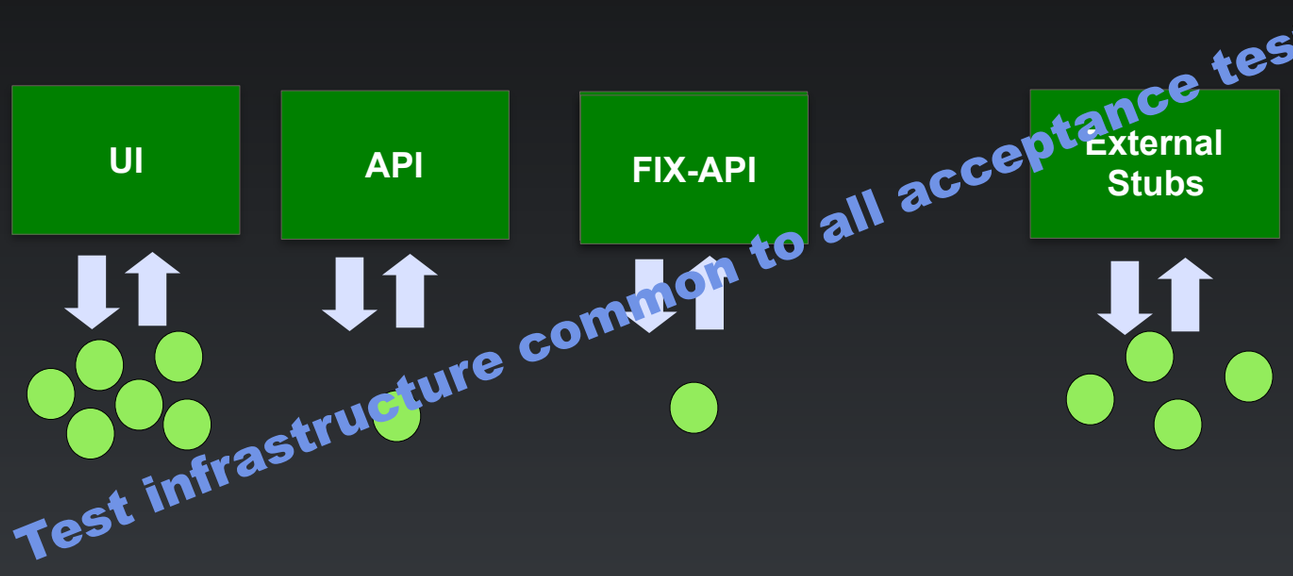

“What” not “How” - Separate Deployment from Testing

- Every Test should control its start conditions, and so should start and init the app.
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- This separation of concerns provides an opportunity for optimisation
  - Parallel tests in a shared environment
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Anti-Pattern!

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Test Isolation

- Any form of testing is about evaluating something in controlled circumstances
- Isolation works on multiple levels
  - Isolating the System under test
  - Isolating test cases from each other
  - Isolating test cases from themselves (temporal isolation)
- Isolation is a vital part of your Test Strategy

Test Isolation - Isolating the System Under Test

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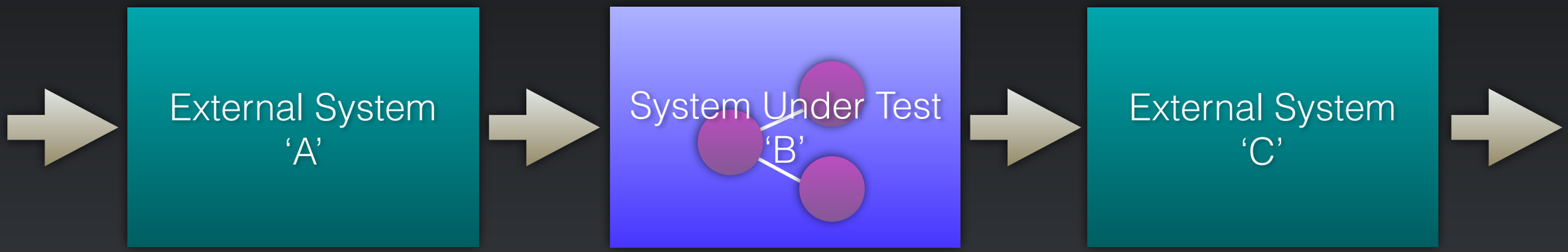

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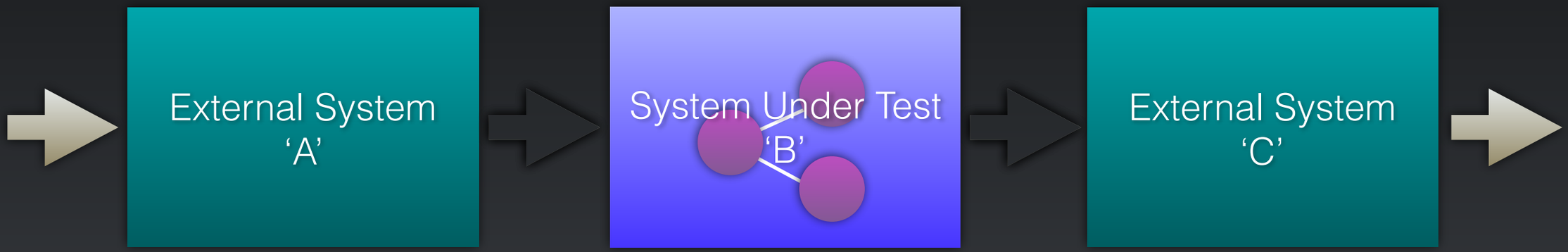

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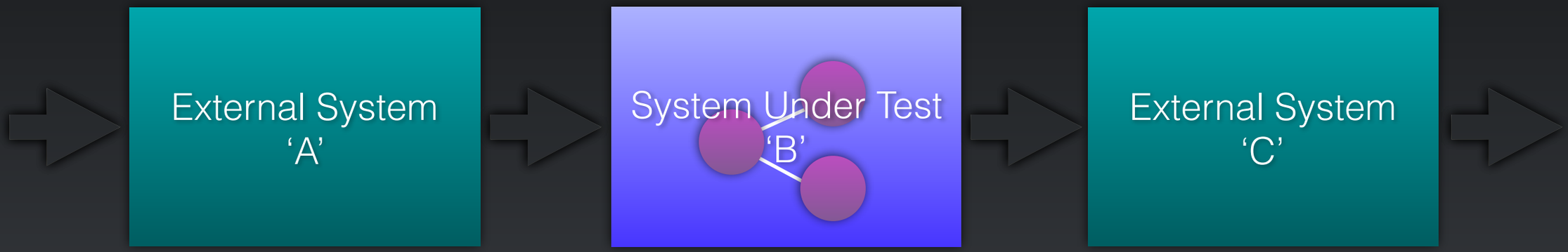

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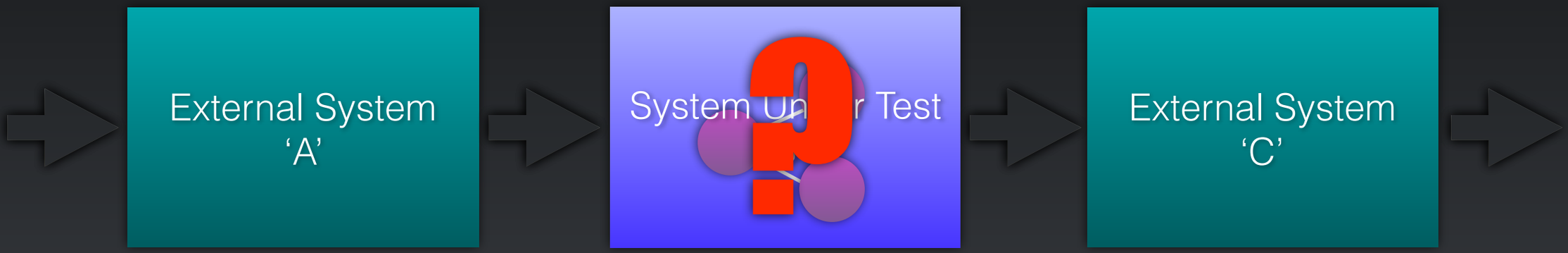

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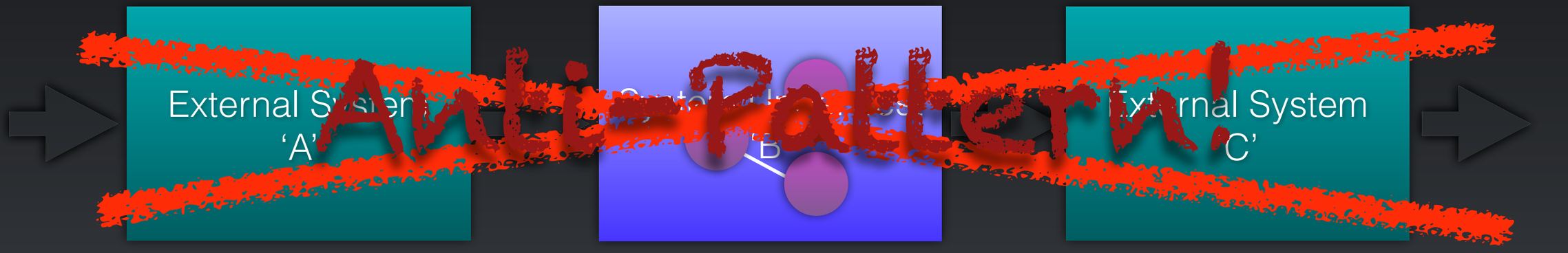

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Test Isolation - Validating The Interfaces

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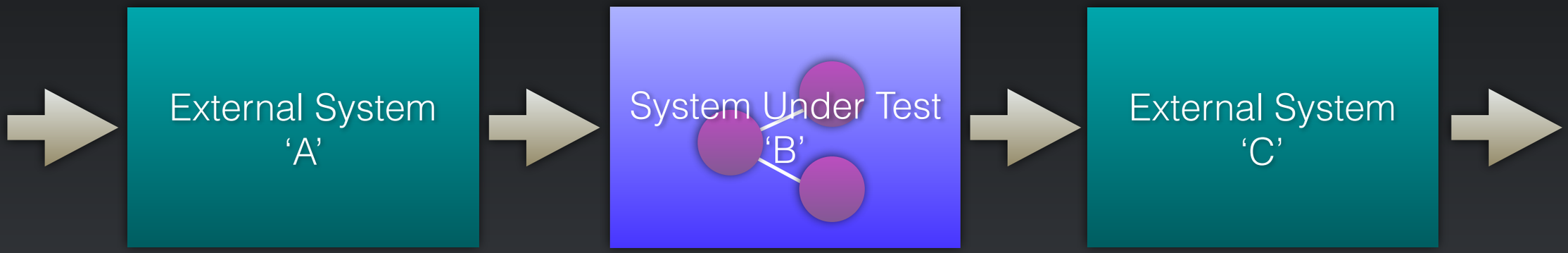

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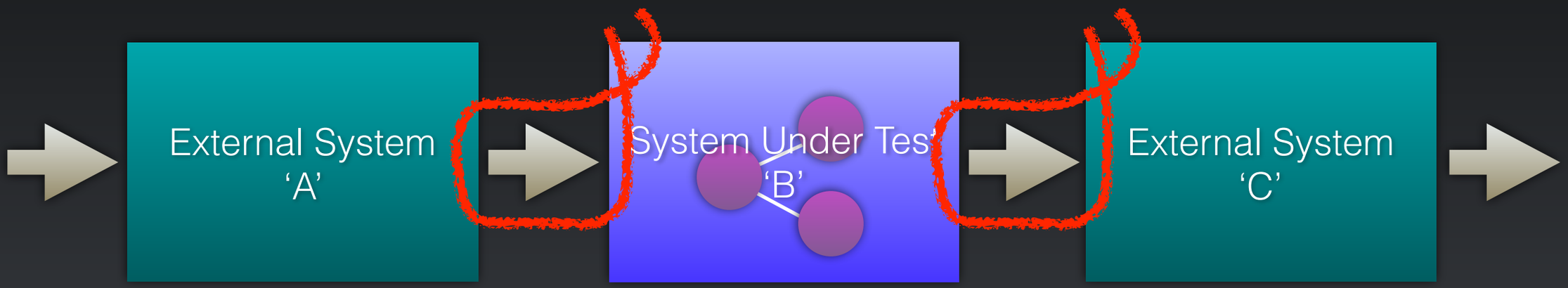

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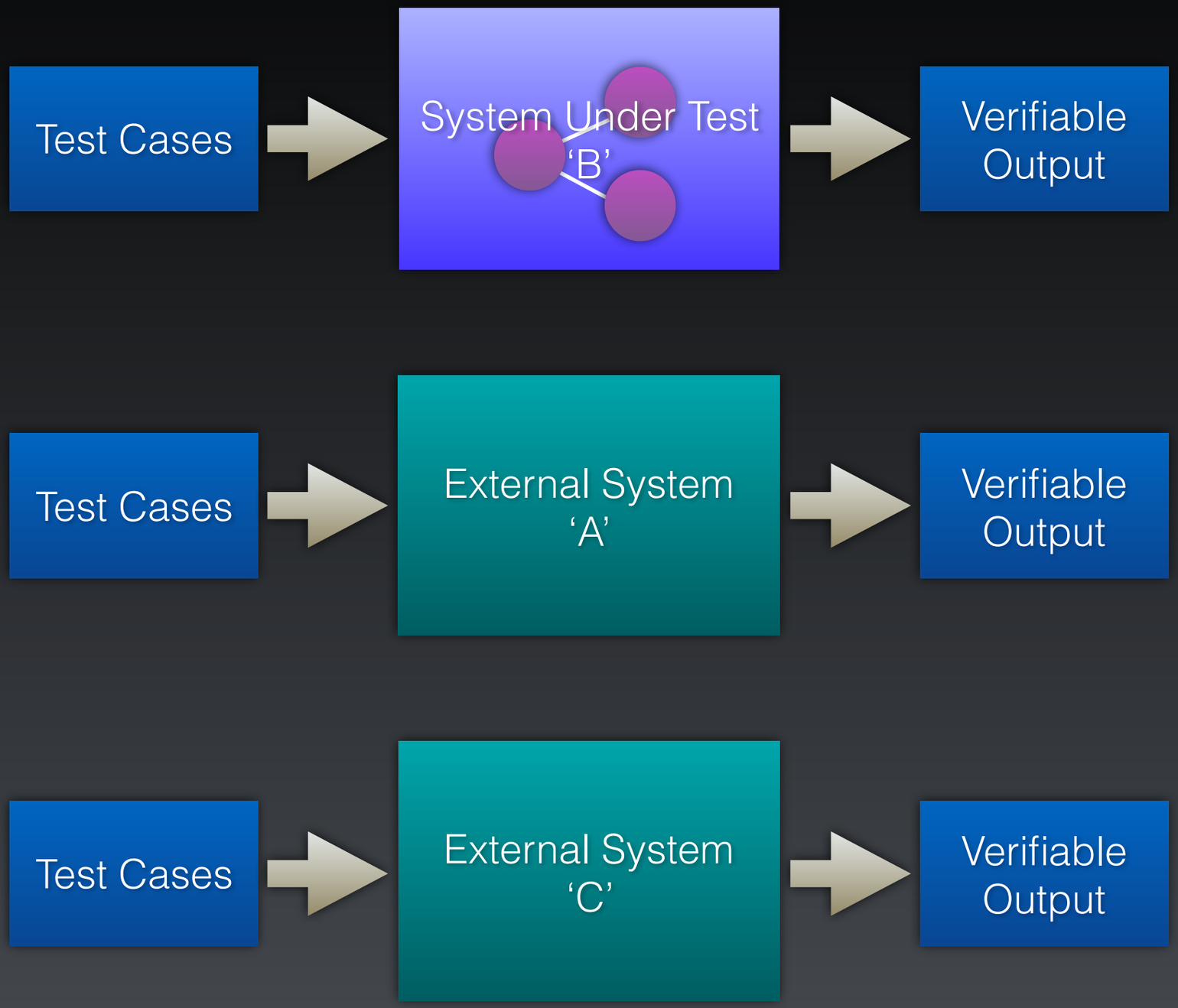

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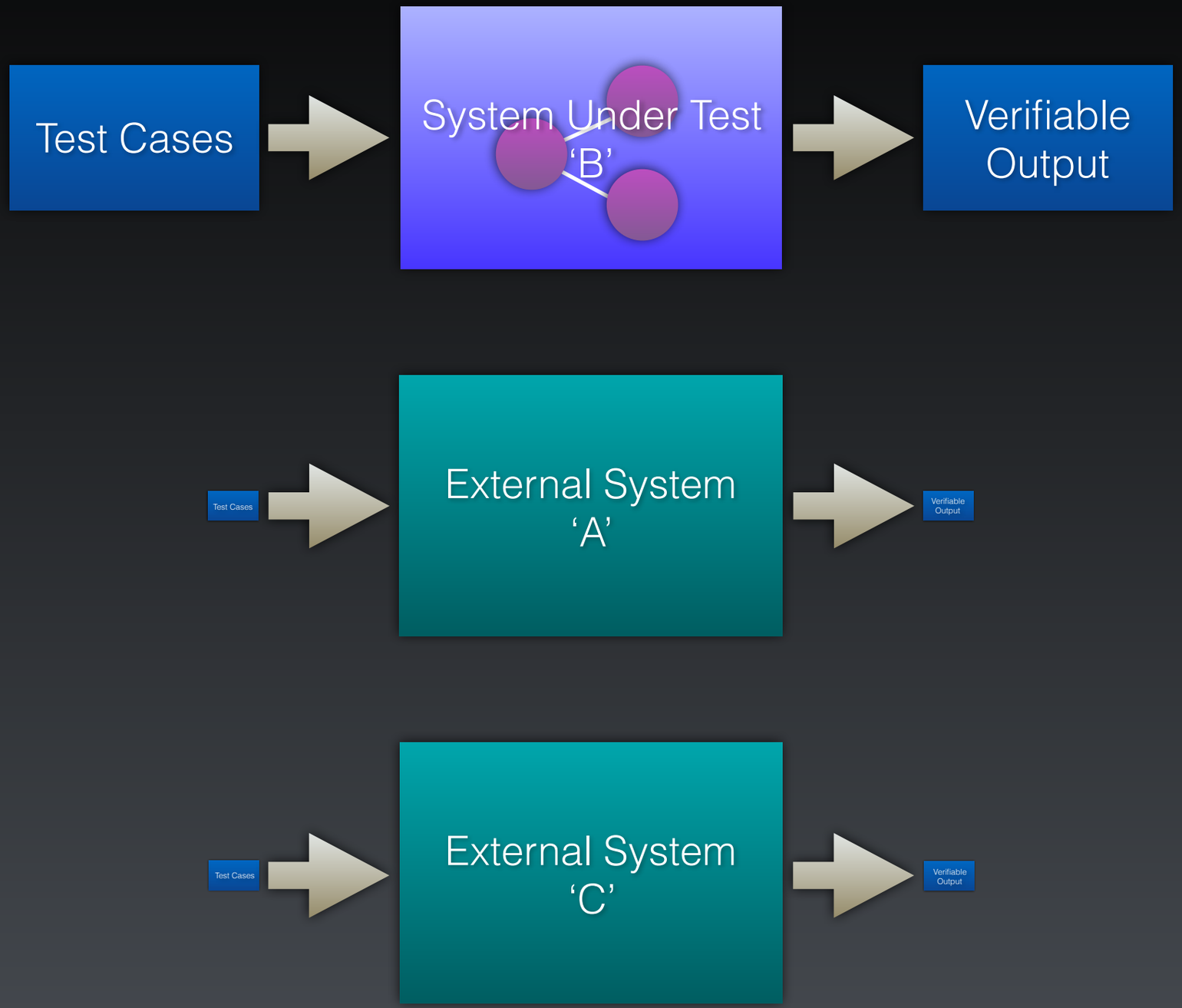

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Test Isolation - Isolating Test Cases

- Assuming multi-user systems…
- Tests should be efficient - We want to run LOTS!
- What we really want is to deploy once, and run LOTS of tests
- So we must avoid ANY dependencies between tests…
- Use natural functional isolation e.g.
  - If testing Amazon, create a new account and a new book/product for every test-case
  - If testing eBay create a new account and a new auction for every test-case
  - If testing GitHub, create a new account and a new repository for every test-case
  - …

Test Isolation - Temporal Isolation

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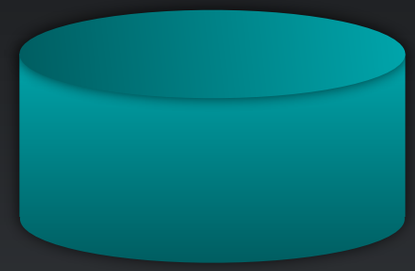

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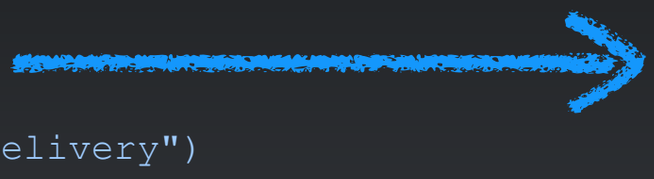


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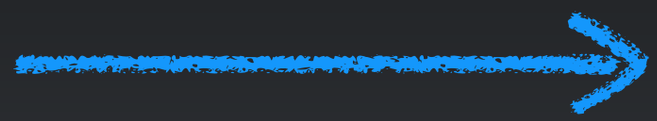


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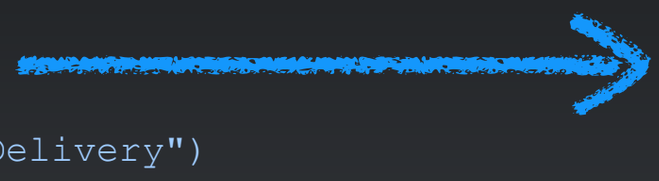


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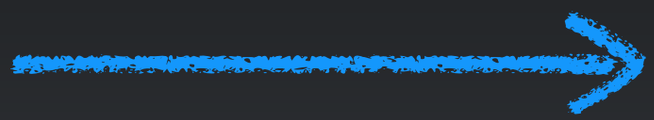


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- Alias your functional isolation entities
  - In your test case create account ‘Dave’ in reality, in the test infrastructure, ask the application to create account ‘Dave2938472398472’ and alias it to ‘Dave’ in your test infrastructure.

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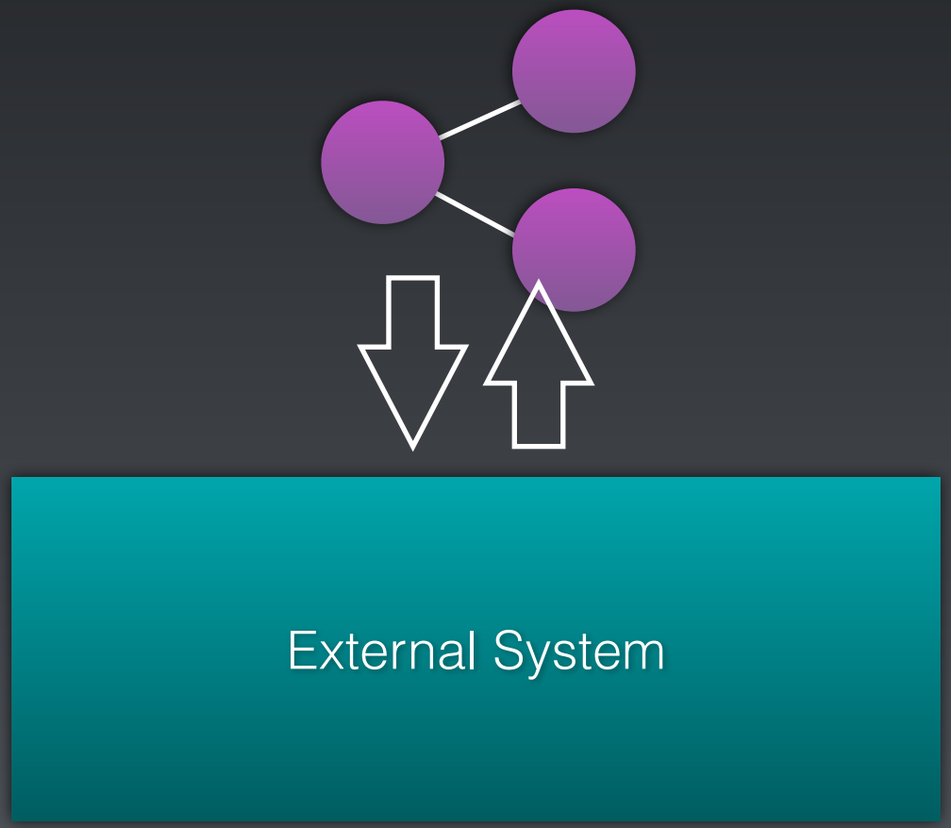

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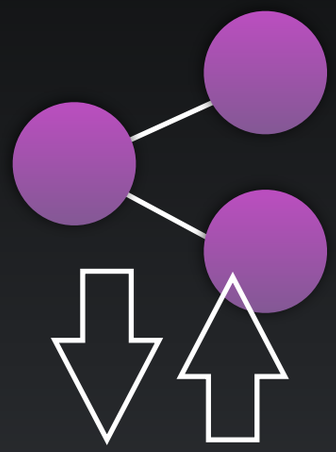

Local Interface
to External System

External System

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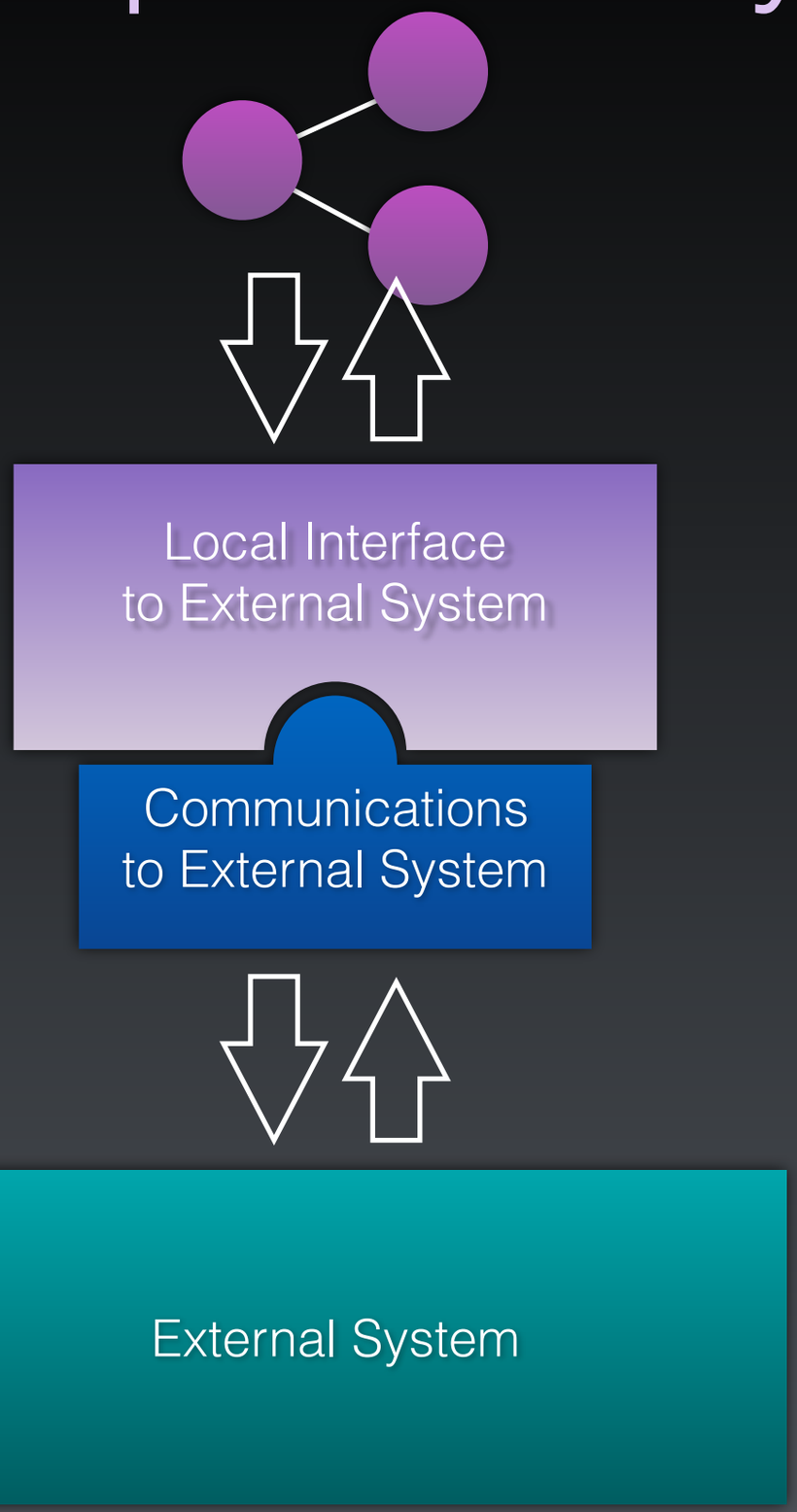

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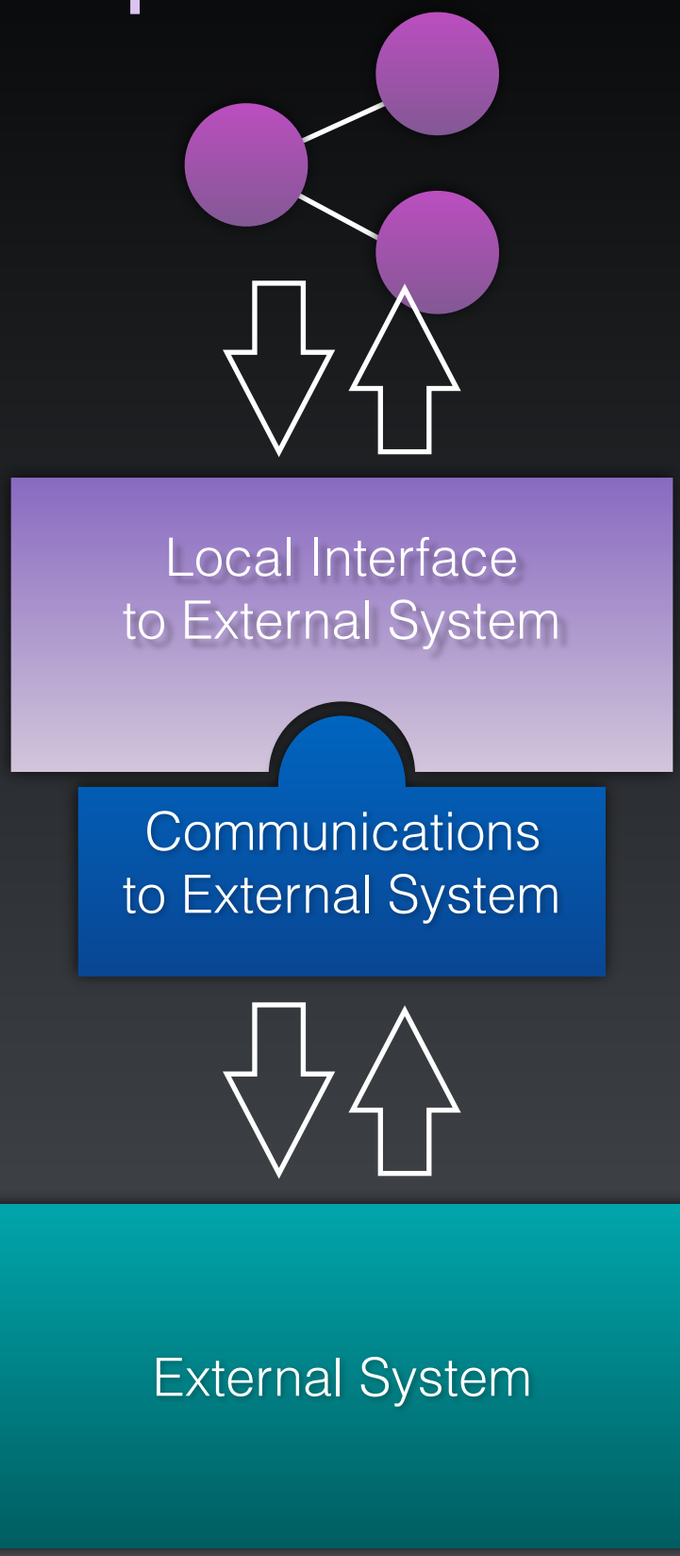

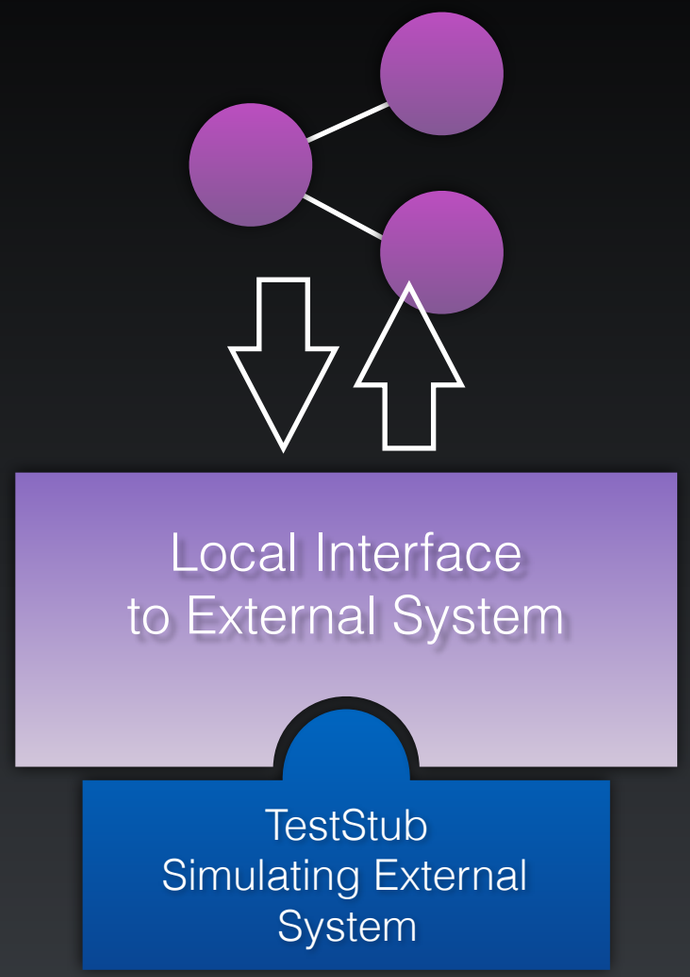

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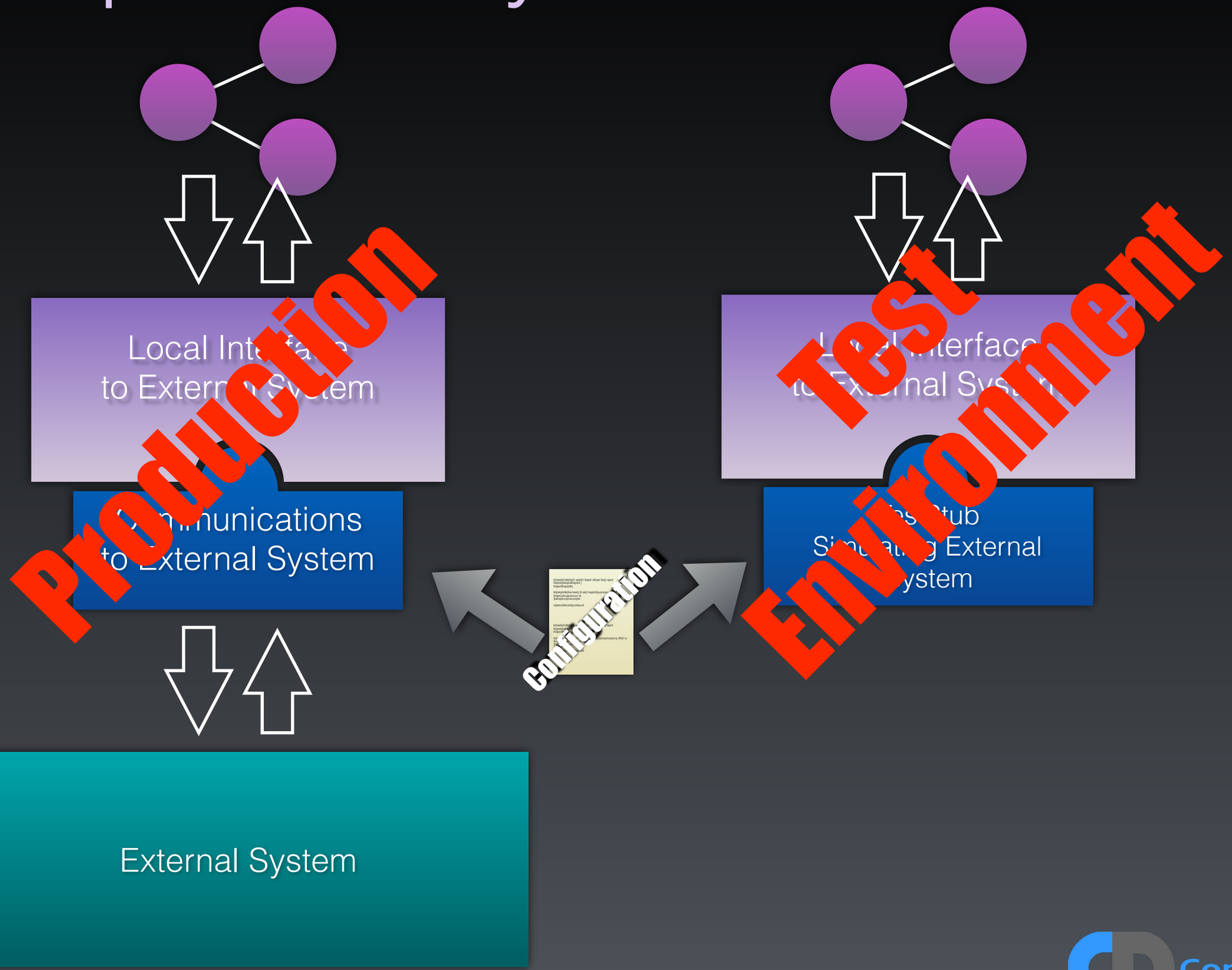

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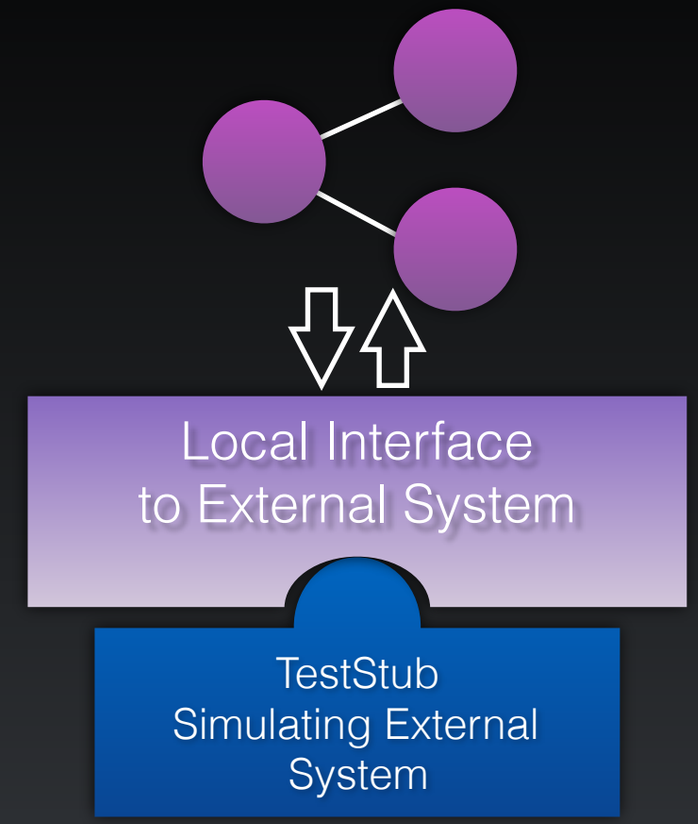
Test Doubles As Part of Test Infrastructure



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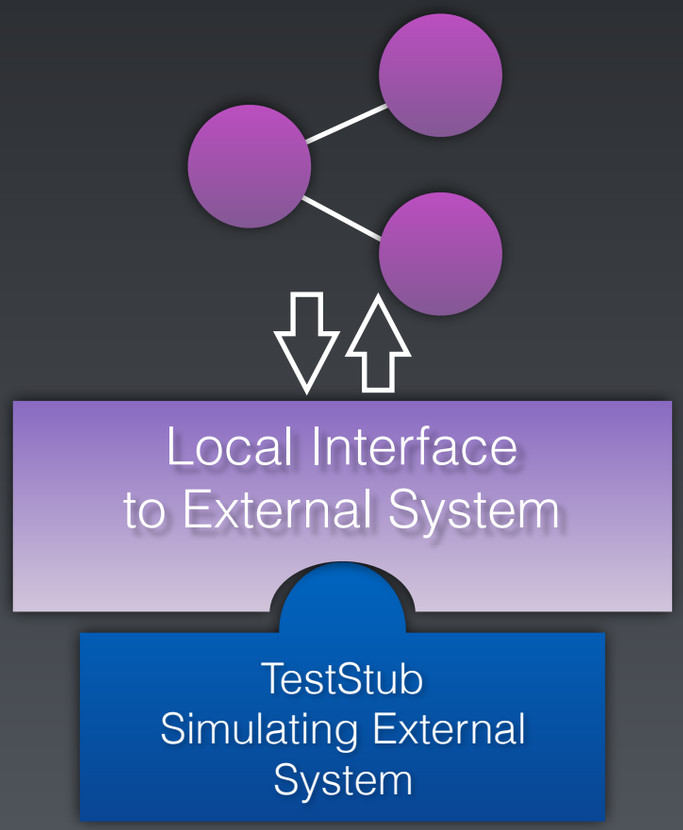

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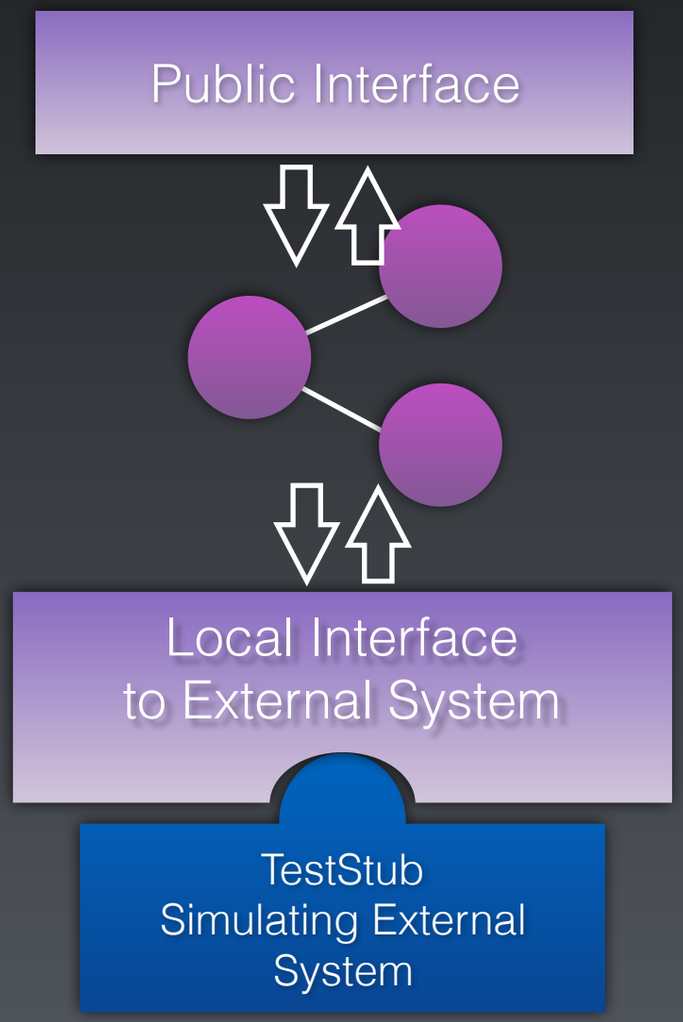

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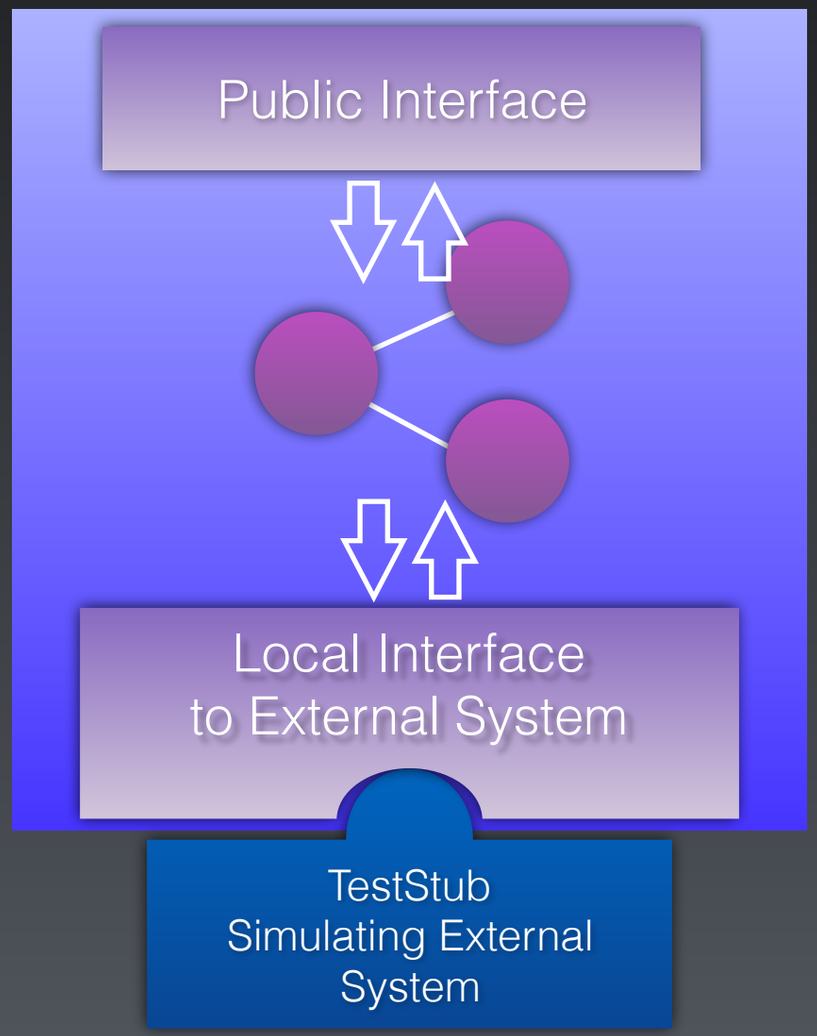

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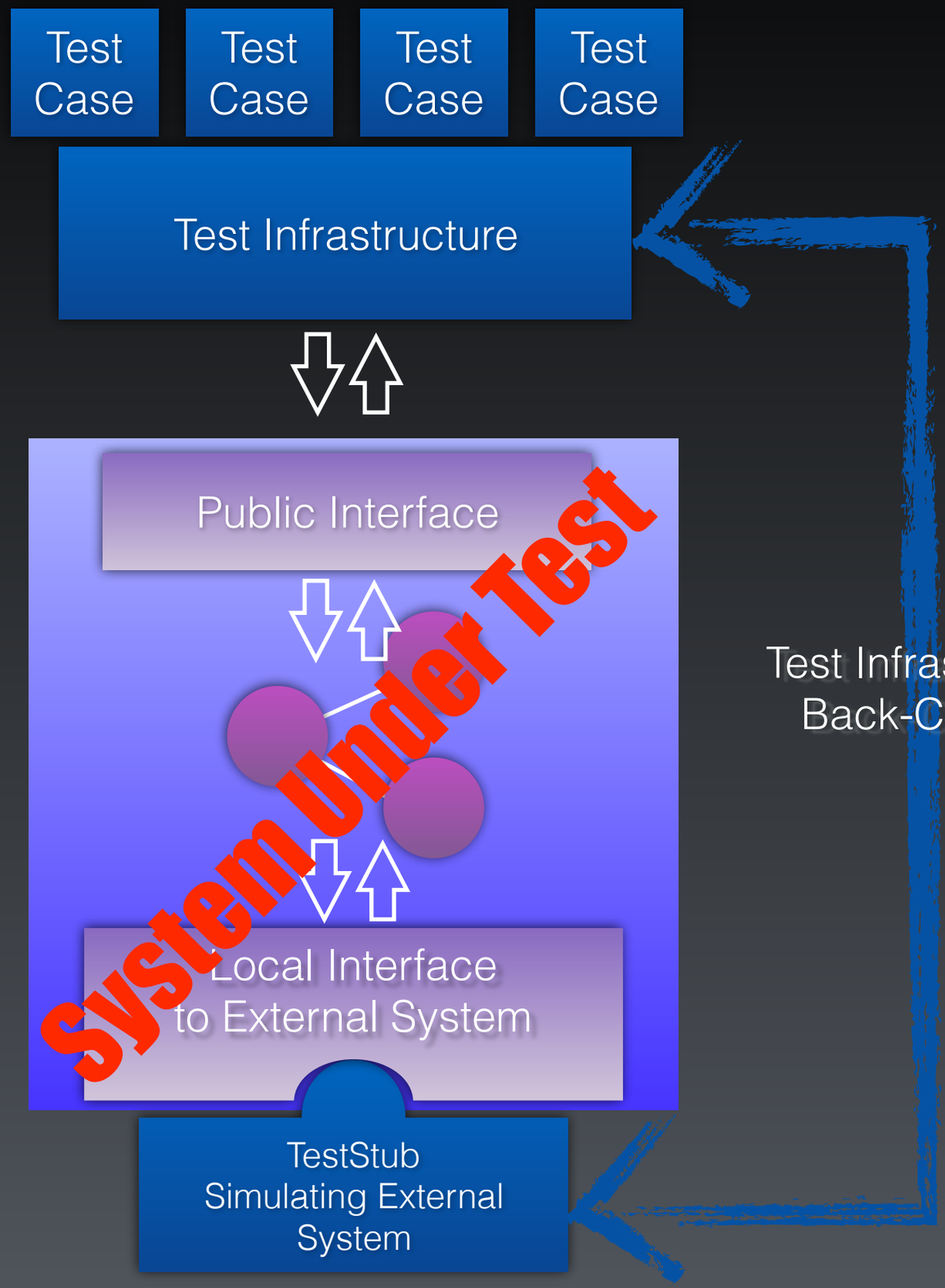

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Language of the Problem Domain - DSL

- A Simple ‘DSL’ Solves many of our problems
  - Ease of TestCase creation
  - Readability
  - Ease of Maintenance
  - Separation of “What” from “How”
  - Test Isolation
  - The Chance to abstract complex set-up and scenarios
  - …

Language of the Problem Domain - DSL

```
@Test
   public void shouldSupportPlacingValidBuyAndSellLimitOrders()
   {
       trading.selectDealTicket("instrument");
       trading.dealTicket.placeOrder("type: limit", ”bid: 4@10”);
       trading.dealTicket.checkFeedbackMessage("You have successfully sent a limit order to buy 4.00 contracts at 10.0");
       trading.dealTicket.dismissFeedbackMessage();

       trading.dealTicket.placeOrder("type: limit", ”ask: 4@9”);
       trading.dealTicket.checkFeedbackMessage("You have successfully sent a limit order to sell 4.00 contracts at 9.0");
   }
```

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   }



@Test
   public void shouldSuccessfullyPlaceAnImmediateOrCancelBuyMarketOrder()
   {
       fixAPIMarketMaker.placeMassOrder("instrument", "ask: 11@52", "ask: 10@51", "ask: 10@50", "bid: 10@49");

       fixAPI.placeOrder("instrument", "side: buy", "quantity: 4", "goodUntil: Immediate", "allowUnmatched: true");
       fixAPI.waitForExecutionReport("executionType: Fill", "orderStatus: Filled",
               "side: buy", "quantity: 4", "matched: 4", "remaining: 0",
               "executionPrice: 50", "executionQuantity: 4");
   }
```

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               "executionPrice: 50", "executionQuantity: 4");
   }



@Before
   public void beforeEveryTest()
   {
       adminAPI.createInstrument("name: instrument");
       registrationAPI.createUser("user");
       registrationAPI.createUser("marketMaker", "accountType: MARKET_MAKER");
       tradingUI.loginAsLive("user");
   }
```

Language of the Problem Domain - DSL

```
public void placeOrder(final String... args)
   {
       final DslParams params =
               new DslParams(args,
                             new OptionalParam("type").setDefault("Limit").setAllowedValues("limit", "market", "StopMarket
                             new OptionalParam("side").setDefault("Buy").setAllowedValues("buy", "sell"),
                             new OptionalParam("price"),
                             new OptionalParam("triggerPrice"),
                             new OptionalParam("quantity"),
                             new OptionalParam("stopProfitOffset"),
                             new OptionalParam("stopLossOffset"),
                             new OptionalParam("confirmFeedback").setDefault("true"));

       getDealTicketPageDriver().placeOrder(params.value("type"),
                                            params.value("side"),
                                            params.value("price"),
                                            params.value("triggerPrice"),
                                            params.value("quantity"),
                                            params.value("stopProfitOffset"),
                                            params.value("stopLossOffset"));

       if (params.valueAsBoolean("confirmFeedback"))
       {
           getDealTicketPageDriver().clickOrderFeedbackConfirmationButton();
       }

       LOGGER.debug("placeOrder(" + Arrays.deepToString(args) + ")");
   }
```

Language of the Problem Domain - DSL

```
@Test
   public void shouldSupportPlacingValidBuyAndSellLimitOrders()
   {
       tradingUI.showDealTicket("instrument");
       tradingUI.dealTicket.placeOrder("type: limit", ”bid: 4@10”);
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       tradingUI.dealTicket.dismissFeedbackMessage();

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                 "side: buy", "quantity: 4", "matched: 4", "remaining: 0",
                 "executionPrice: 50", "executionQuantity: 4");
   }
```

Language of the Problem Domain - DSL

```
@Channel(fixApi, dealTicket, publicApi)
@Test
    public void shouldSuccessfullyPlaceAnImmediateOrCancelBuyMarketOrder()
    {
          trading.placeOrder("instrument", "side: buy", “price: 123.45”, "quantity: 4", "goodUntil: Immediate”);
          trading.waitForExecutionReport("executionType: Fill", "orderStatus: Filled",
                                         "side: buy", "quantity: 4", "matched: 4", "remaining: 0",
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Testing with Time

- Test Cases should be deterministic
- Time is a problem for determinism - There are two options:
  - Ignore time
  - Control time

Testing With Time - Ignore Time

Mechanism

Filter out time-based values in your test infrastructure so that they are ignored

Pros:

- Simple!

Cons:

- Can miss errors
- Prevents any hope of testing complex time-based scenarios

Testing With Time - Controlling Time

Mechanism

Treat Time as an external dependency, like any external system - and Fake it!

Pros:

- Very Flexible!
- Can simulate any time-based scenario, with time under the control of the test case.

Cons:

- Slightly more complex infrastructure

Testing With Time - Controlling Time

```
@Test
    public void shouldBeOverdueAfterOneMonth()
    {
        book = library.borrowBook("Continuous Delivery");
        assertFalse(book.isOverdue());

        time.travel("+1 week");
        assertFalse(book.isOverdue());

        time.travel("+4 weeks");
        assertTrue(book.isOverdue());
}
```

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Testing With Time - Controlling Time

```
@Test
    public void shouldBeOverdueAfterOneMonth()
    {
        book = library.borrowBook("Continuous Delivery");
        assertFalse(book.isOverdue());

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Testing With Time - Controlling Time

Testing With Time - Controlling Time

Test Case | Test Case | Test Case | Test Case

Test Infrastructure

System under Test

```
public void someTimeDependentMethod()
{
        time = System.getTime();
}
```

Testing With Time - Controlling Time

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System Under Test

```
include Clock;

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        time = Clock.getTime();
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Testing With Time - Controlling Time

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Test Infrastructure

```
include Clock;

public void someTimeDependentMethod()
{
        time = Clock.getTime();
}
```

```
public class Clock {
    public static clock = new SystemClock();

    public static void setTime(long newTime) {
        clock.setTime(newTime);
    }

    public static long getTime() {
        return clock.getTime();
    }
```

System Under Test

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Testing With Time - Controlling Time

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Test Infrastructure

```
include Clock;

public void someTimeDependentMethod()
{
        time = Clock.getTime();
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System Under Test

```
public class Clock {
    public static clock = new SystemClock();

    public static void setTime(long newTime) {
        clock.setTime(newTime);
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        return clock.getTime();
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```

Test Infrastructure Back-Channel

```
public void onInit() {
// Remote Call - back-channel
        systemUnderTest.setClock(new TestClock());
}

public void time-travel(String time) {
        long newTime = parseTime(time);

// Remote Call - back-channel
        systemUnderTest.setTime(newTime);
}
```

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Test Environment Types

- Some Tests need special treatment.
- Tag Tests with properties and allocate them dynamically:

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```
@TimeTravel
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public void shouldDoSomethingThatNeedsFakeTime()
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public void shouldDoSomethingThatKillsPartOfTheSystem()
…
@FPGA(version=1.3)
@Test
public void shouldDoSomethingThatRequiresSpecificHardware()
…
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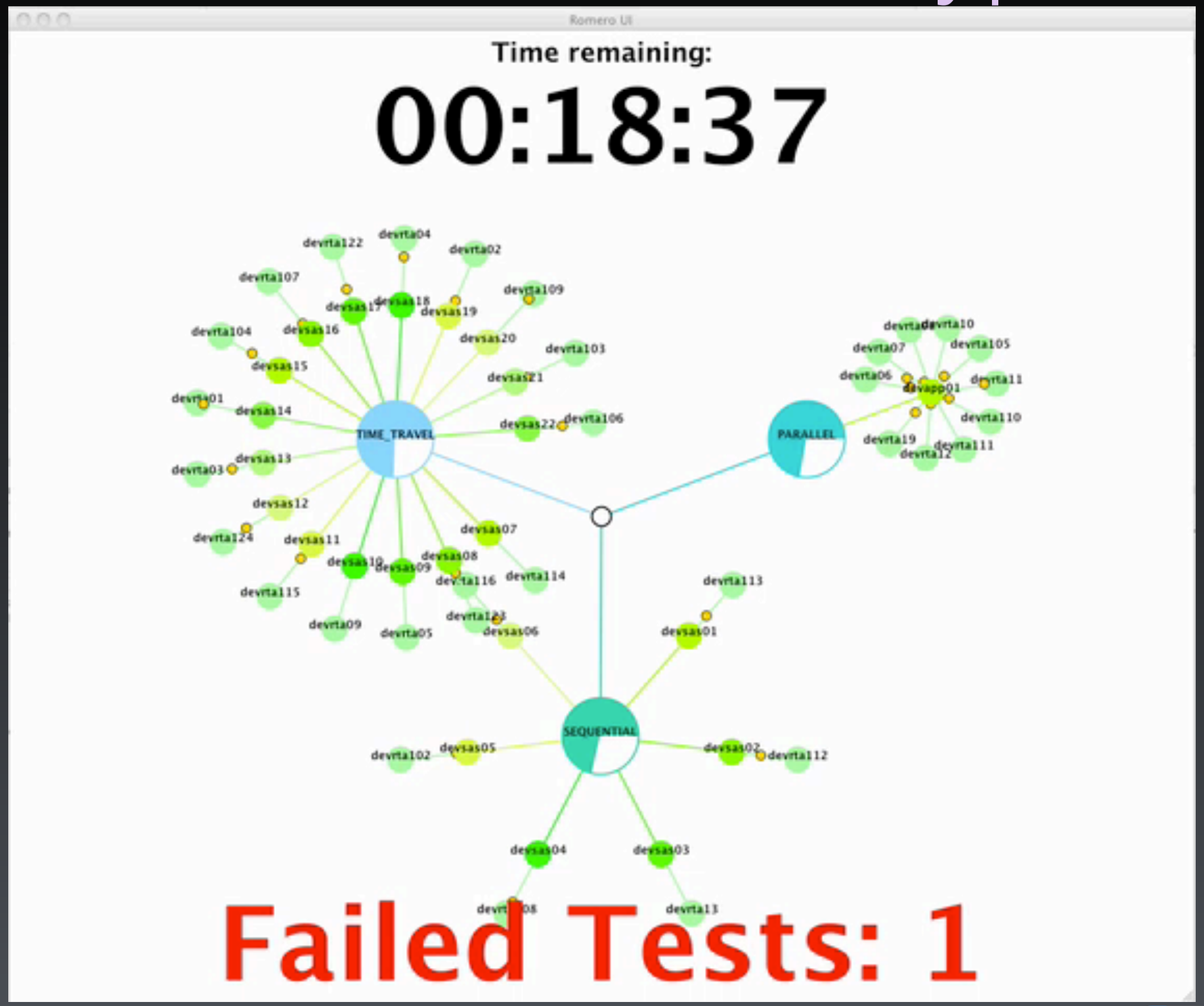

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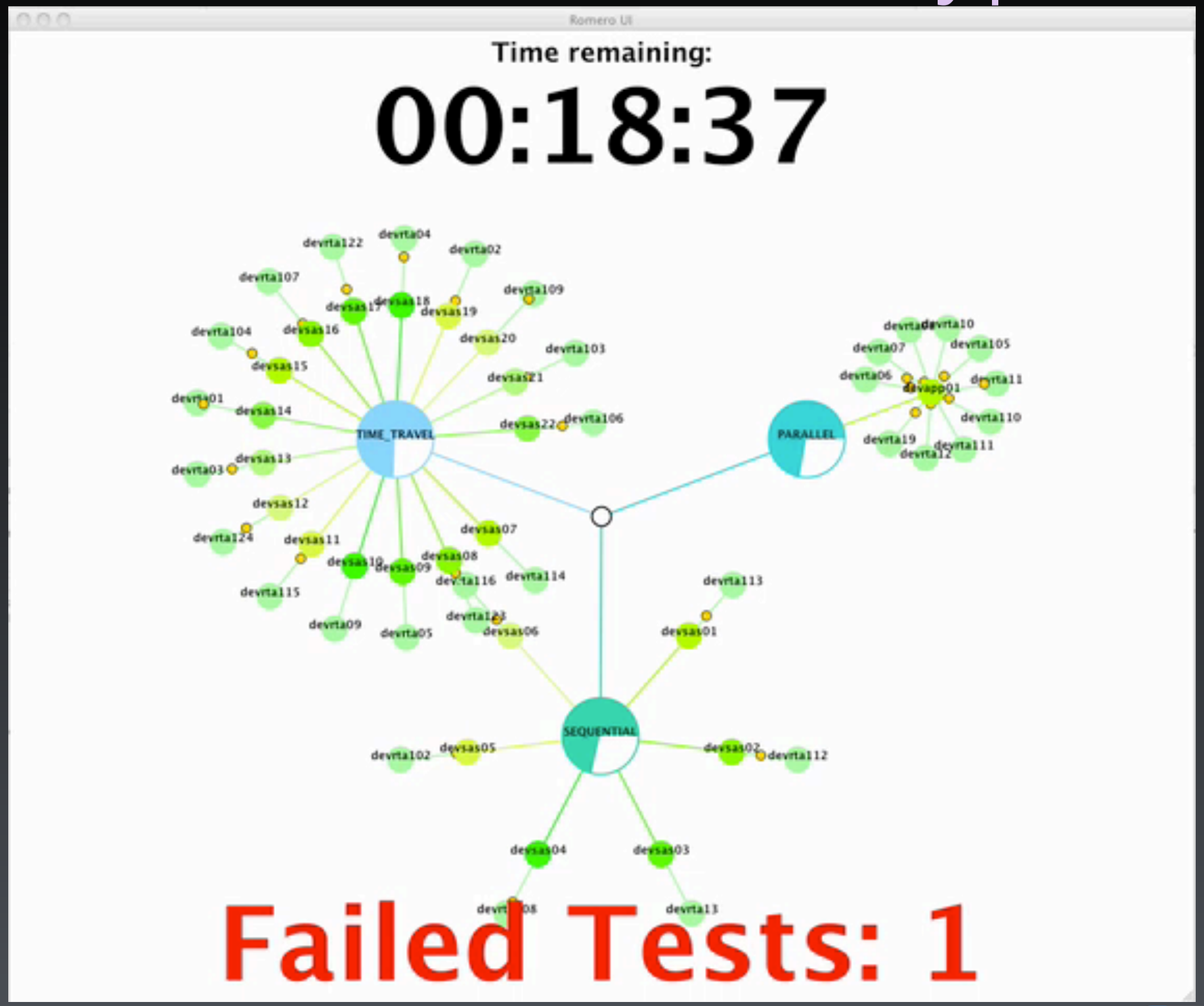

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Production-like Test Environments

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Example DSL level Implementation…

```
public String placeOrder(String params…)
{
  orderSent = sendAsyncPlaceOrderMessage(parseOrderParams(params));
  return waitForOrderConfirmedOrFailOnTimeOut(orderSent);
}
```

Make Test Cases Internally Synchronous

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- If you really have to, implement a “poll-and-timeout” mechanism in your test-infrastructure
- Never, Never, Never, put a “wait(xx)” and expect your tests to be (a) Reliable or (b) Efficient!

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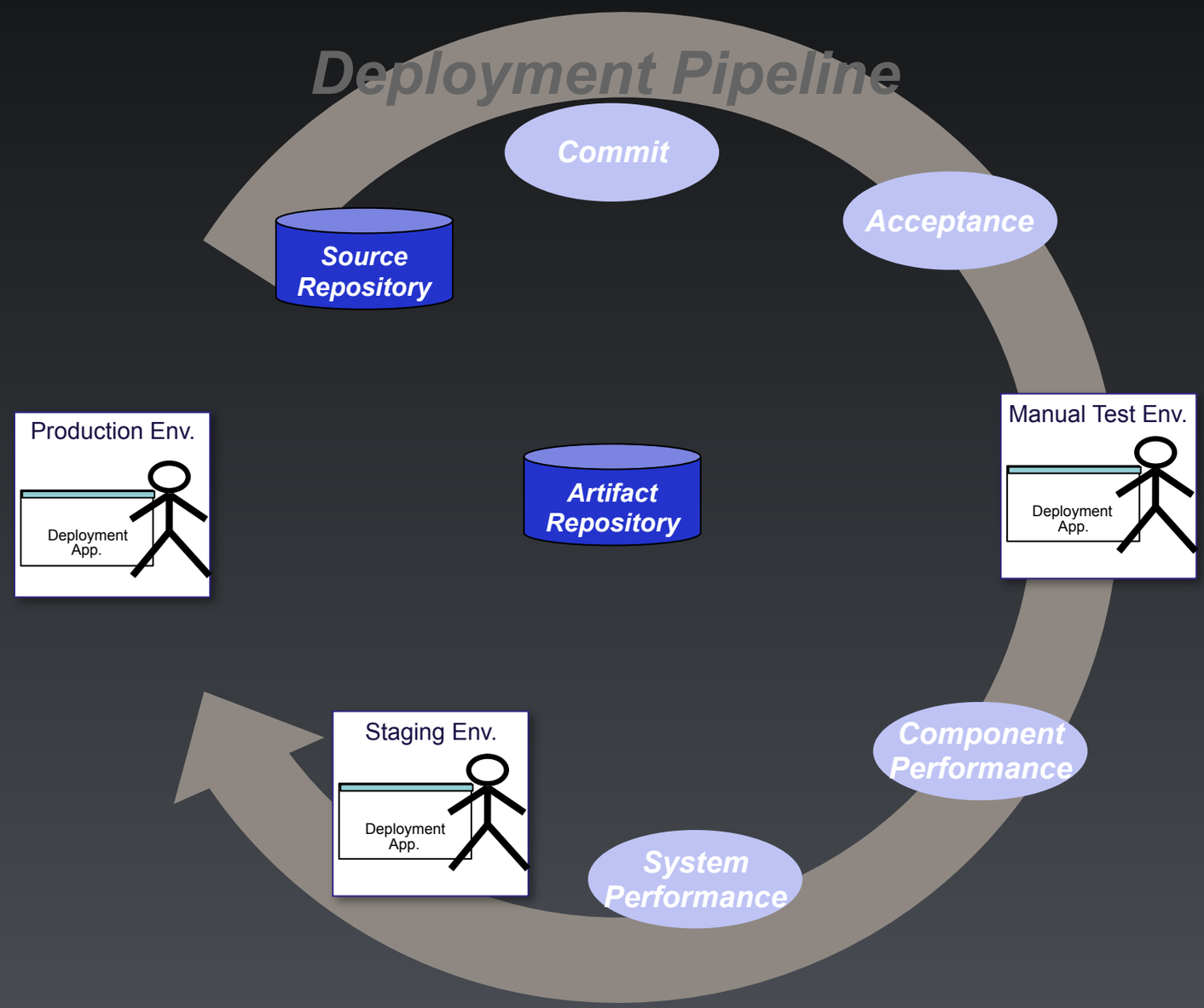
Anti-Pattern!

Scaling-Up



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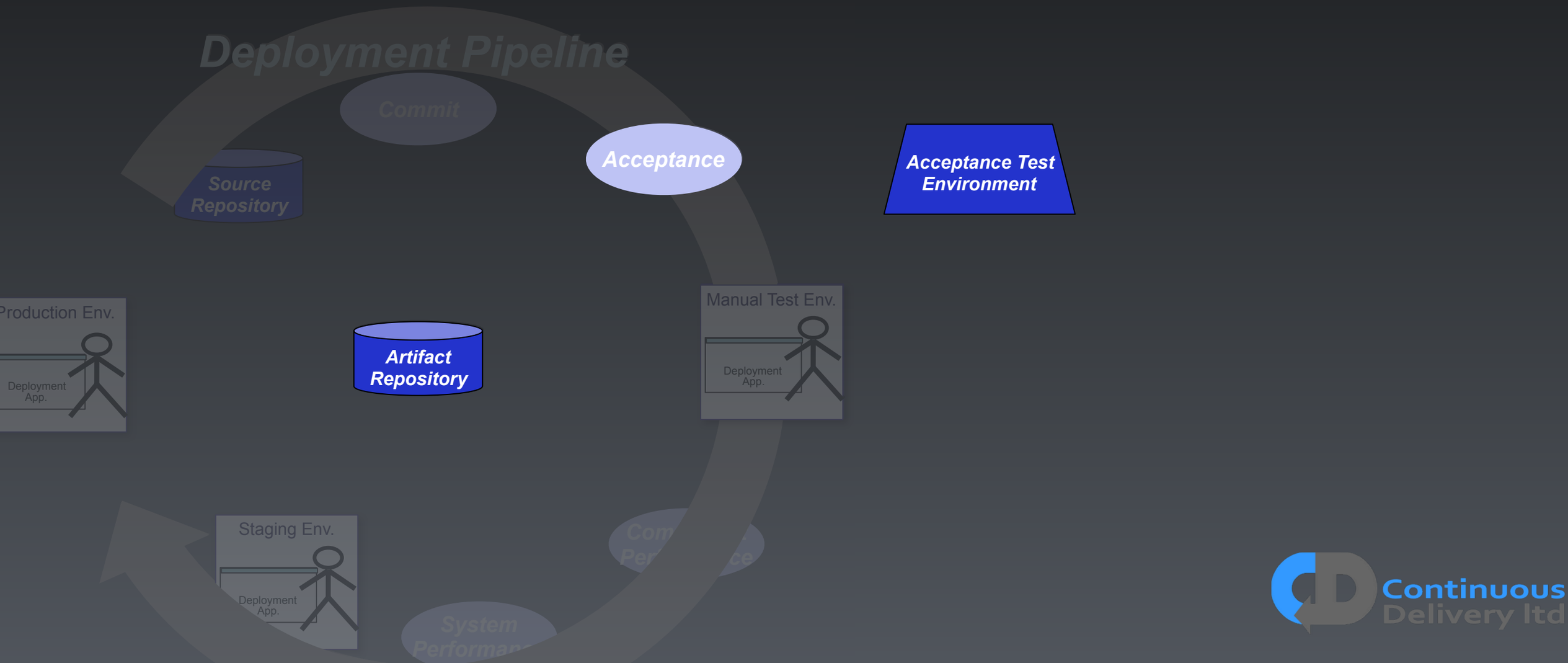
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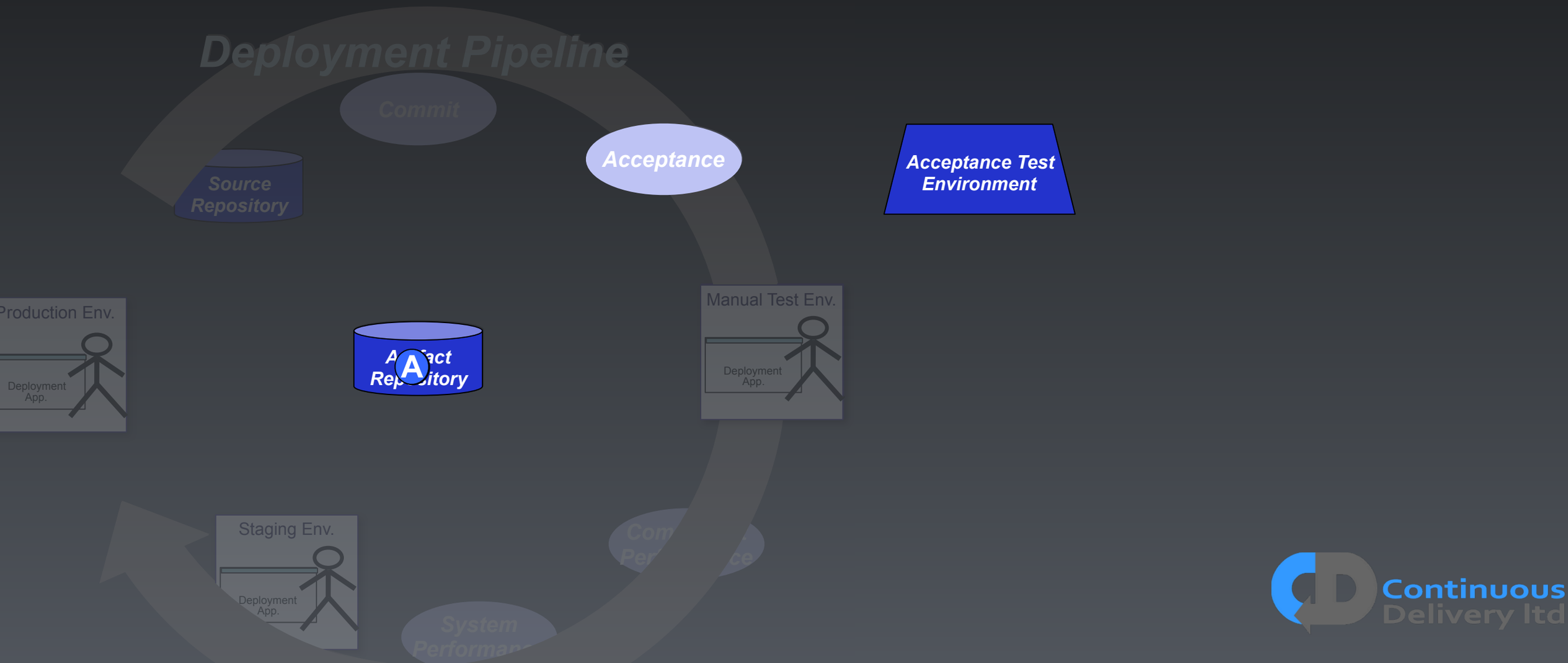
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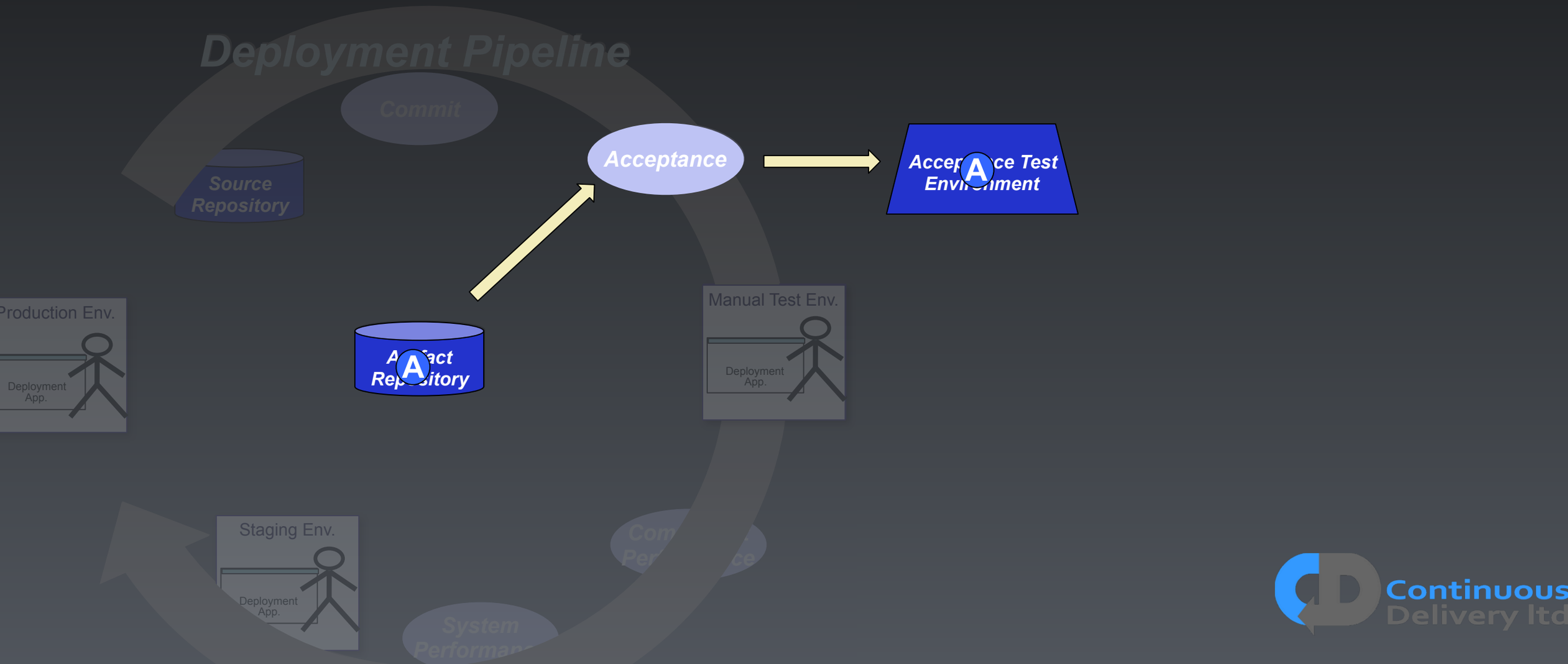

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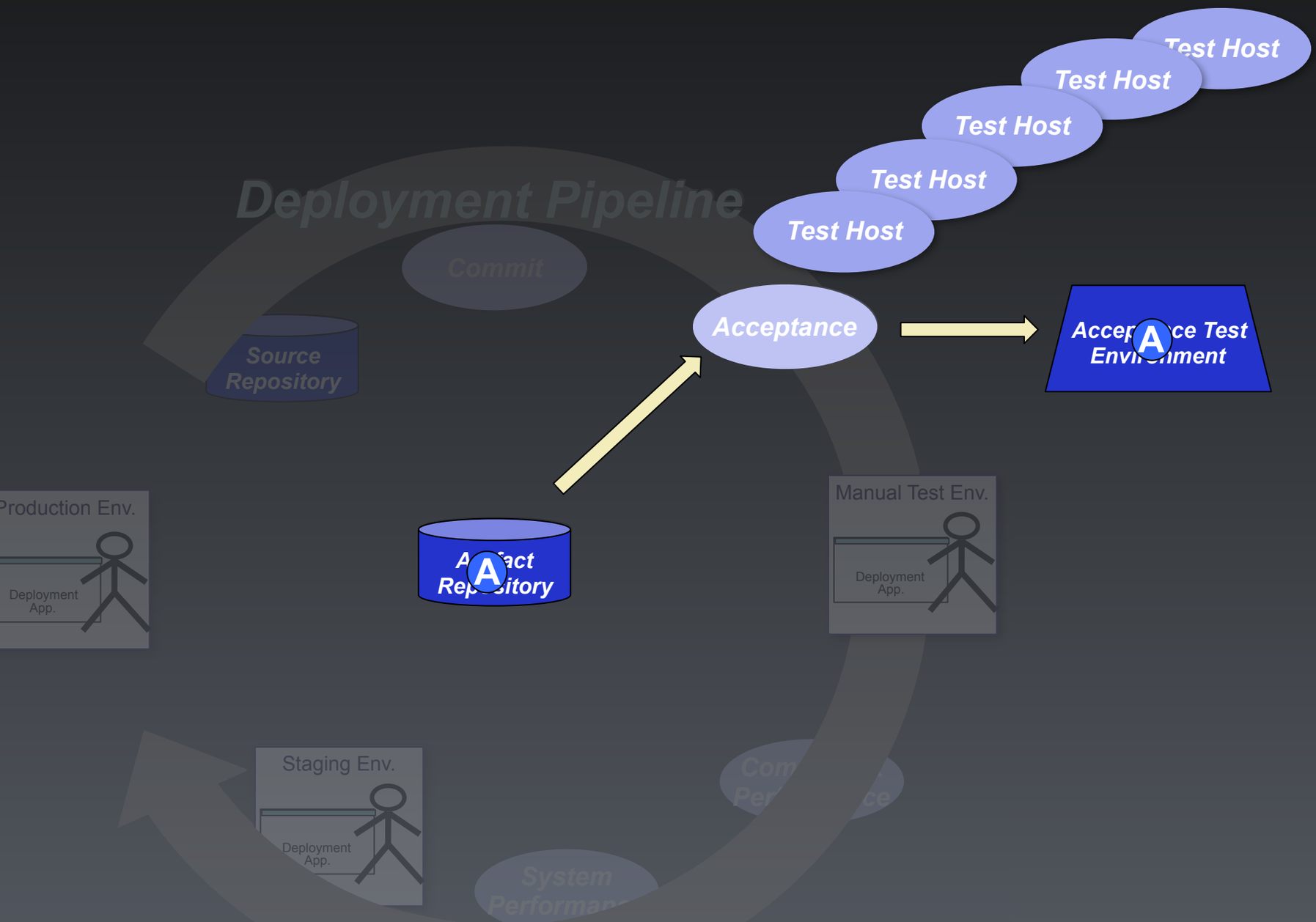

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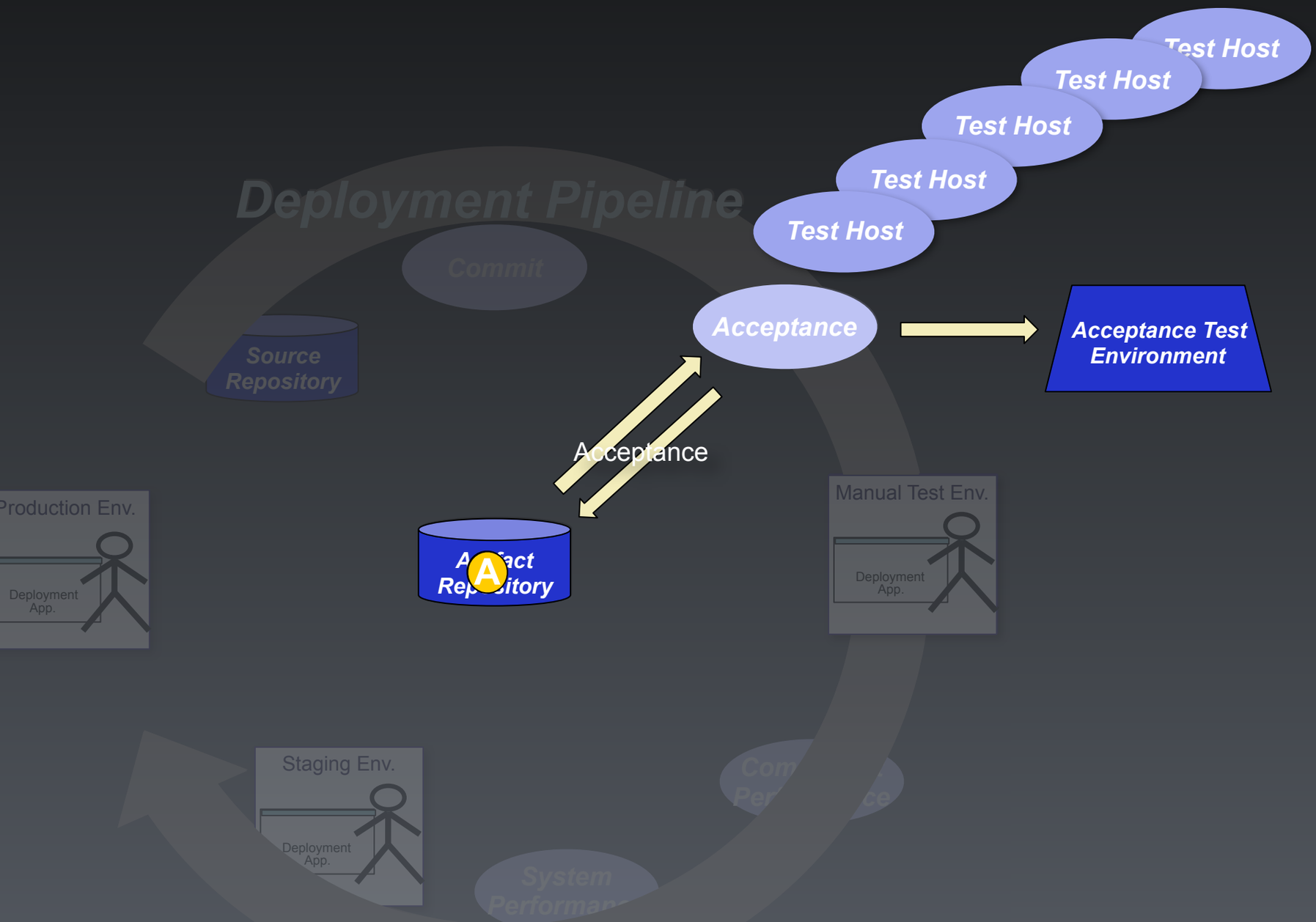

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- **Don't** Put 'wait()' instructions in your tests hoping it will solve intermittency

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Q&A

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