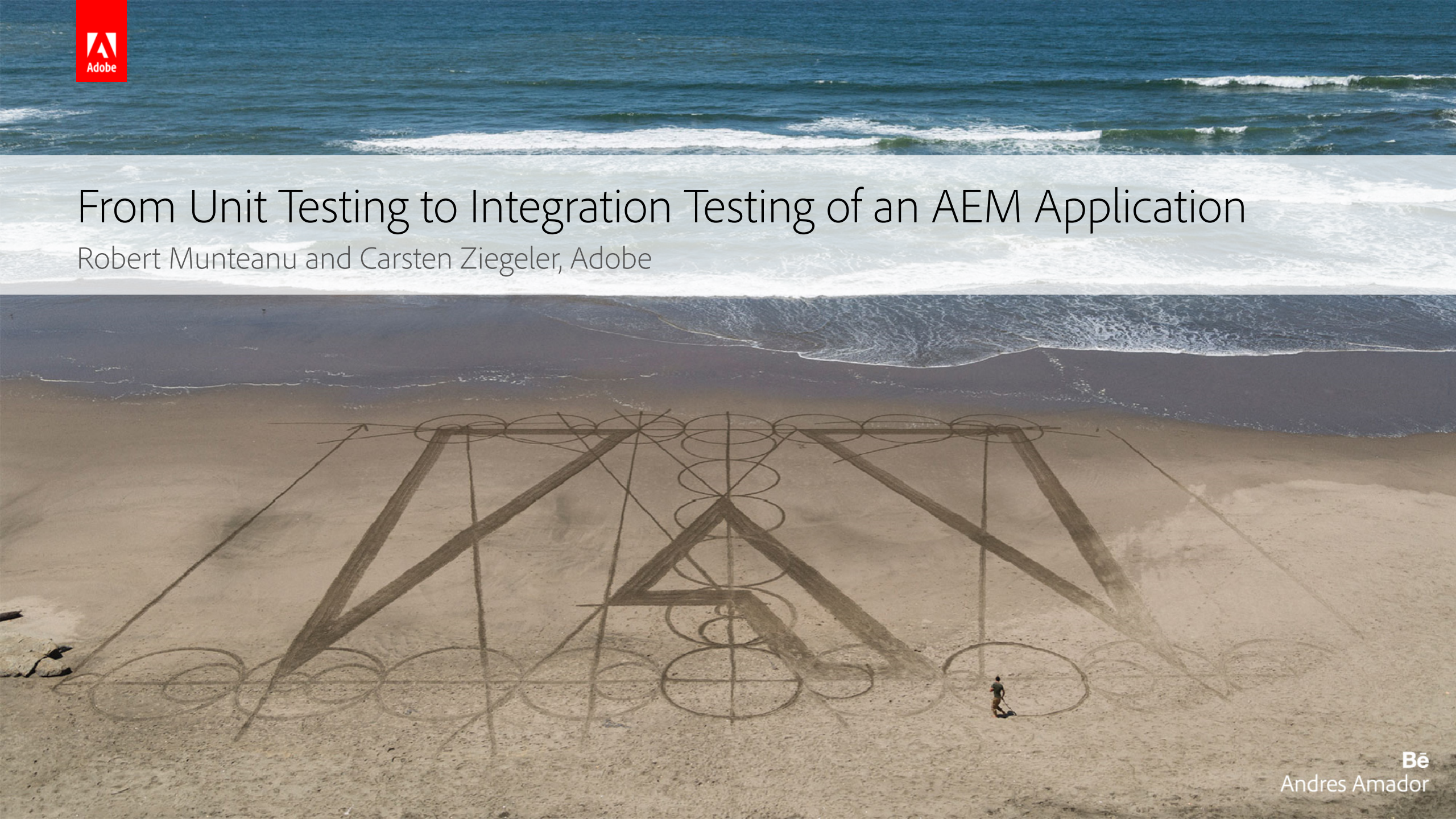
From Unit Testing to Integration Testing of an AEM Application

Robert Munteanu and Carsten Ziegeler, Adobe



Robert Munteanu

- Adobe Systems Romania
- AEM Developer, focusing on lower layers of the stack
- Apache Sling PMC member

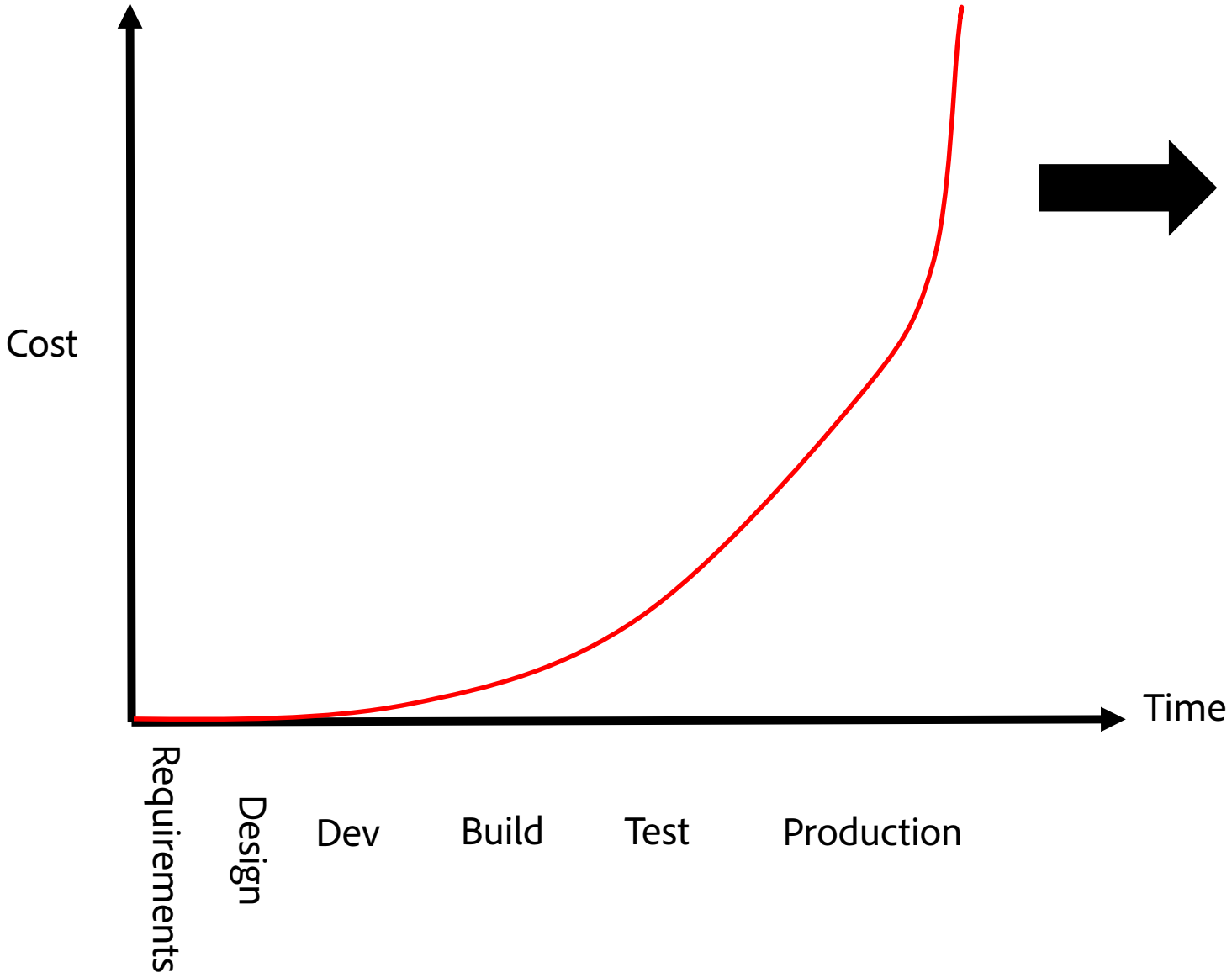
Carsten Ziegeler

- RnD Adobe Research Switzerland
- Project Lead / Founder of Adobe Granite
- Member of the Apache Software Foundation
- VP of Apache Felix and Sling
- OSGi Expert Groups and Board member

Agenda

- Unit testing intro
- OSGi Unit testing
- Sling Unit testing
- AEM Mocks
- Pax-Exam
- End-to-End testing

The Cost of Fixing Defects



The earlier defects are found the less expensive is the fix

Automated testing is imperative!

Frequent and fast testing!

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Testing an AEM Application

- Java Code
- Scripts
- Javascript
- REST API
- HTML / CSS

Phase One – Unit Testing

- Maven Setup
  - All tests go at src/test/java
  - Include junit as test dependency
- Create test class, annotate method with org.junit.Test annotation
- Assertions from org.junit.Assert.*
- Use Before / After annotation for setup / clean up

JUnit Test

Source src/main/java: org.apache.sling.resource.ResourceUtil

```
public static @CheckForNull String getParent(@Nonnull String path) {
...
```

Test src/test/java: org.apache.sling.resource.ResourceUtilTest

```
@Test public void testGetParent() {
        assertNull(ResourceUtil.getParent("/"));
        assertNull(ResourceUtil.getParent("/.."));

        assertEquals("/", ResourceUtil.getParent("/b"));
        assertEquals("b/c", ResourceUtil.getParent("b/c/d"));
        assertEquals("/b/c", ResourceUtil.getParent("/b/c/d"));
        ...
}
```

Mocking

Business objects, services, data...

- Use real classes / implementations
- Create own implementations
- Mocks

Mocking

```
public class MyService {

     public String readData(ResourceResolver resolver, String path) {
          Resource r = resolver.getResource(path);
          return r == null ? null : r.adaptTo(String.class);
     }
}
```

```
@Test public void testReadData() {

        MyService service = new MyService();
        assertEquals("OK", service.readData(resolver, "/content/data/testdata"));
}
```

Mocking with mockito

```
public class MyService {

     public String readData(ResourceResolver resolver, String path) {
          Resource r = resolver.getResource(path);
          return r == null ? null : r.adaptTo(String.class);
     }
}

@Test public void testReadData() {
        ResourceResolver resolver = mock(ResourceResolver.class);
        Resource rsrc = mock(Resource.class);
        when(resolver.getResource("/content/data/testdata")).thenReturn(rsrc);
        when(rsrc.adaptTo(String.class)).thenReturn("OK");

        MyService service = new MyService();
        assertEquals("OK", service.readData(resolver, "/content/data/testdata"));
}
```

Mocking with mockito

```
@Test public void testReadData() {
        ResourceResolver resolver = mock(ResourceResolver.class);
        Resource rsrc = mock(Resource.class);
        when(resolver.getResource("/content/data/testdata")).thenReturn(rsrc);
        when(rsrc.adaptTo(String.class)).thenReturn("OK");

        MyService service = new MyService();
        assertEquals("OK", service.readData(resolver, "/content/data/testdata"));

        verify(resolver).getResource("/content/data/testdata");
        verifyNoMoreInteractions(resolver);
}
```

Mocking

- Easy but powerful
- Expectations
- Verifications
- Complex matching possible

- But keep it simple – or do you want to write tests for your tests?
- And/or: „Don‘t mock a type you don‘t own“

Phase Two– Apache Sling's Resource Resolver Mock Library

Testing Code using Resource API

- [redacted]
- [redacted]
- [redacted]

Apache Sling Testing Resource Resolver Mock

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Apache Sling Testing Resource Resolver Mock

```
ResourceResolverFactory factory = new MockResourceResolverFactory();
ResourceResolver resolver = factory.getResourceResolver(null);


resolver.getResource("/my/path");
resource.adaptTo(ValueMap.class);
resolver.create(parent, "new resource", properties);
resolver.delete(resource);
resource.adaptTo(ModifiableValueMap.class);
resolver.commit();
resolver.revert();
```

Apache Sling Testing Resource Resolver Mock

```
MockHelper.create(resolver)
 .resource("/apps")
   .resource("1").p("a", "1").p("b", "2")
   .resource(".2").p(ResourceResolver.PROPERTY_RESOURCE_TYPE, "apps")
   .resource(".3").p("e", "2")
                  .p(ResourceResolver.PROPERTY_RESOURCE_TYPE, "apps")

 .resource("/libs")
   .resource("1").p("d", "1").p("b", "5")
   .resource(".2").p(ResourceResolver.PROPERTY_RESOURCE_TYPE, "apps")
   .resource(".4").p("f", "2");
```

Phase Three– Apache Sling's Mock Library Family

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Mocks are great, but what about....

- OSGi services
- Especially referencing other services
- OSGi configurations
- More complicated test setups
- ...

Family of Apache Sling Mocking Libraries

- Sling Mocks
- JCR Mocks
- OSGi Mocks
- Tooling

Simple OSGi Example - Service

```
public interface MyService {

    String getMessage();
}
```

Simple OSGi Example - Implementation

```
@Component(service=MyService.class)
public class MyComponent implements MyService {

    @Reference
    private EventAdmin eventAdmin;

    private String message = "Hello";

    @Activate
    private void activate(final Map<String, Object> config) {
        message = (String) config.get("message");
    }

    @Override
    public String getMessage() {
        return message;
    }
}
```

Simple OSGi Example - Test

```
public class MyComponentTest {

    @Rule
    public SlingContext context = new SlingContext();

    @Test public void testMessage() {
        context.registerService(EventAdmin.class, mock(EventAdmin.class));

        MyService service = context.registerInjectActivateService(
                new MyComponent(),
                Collections.singletonMap("message", "YOU"));

        assertEquals("YOU", service.getMessage());
    }
}
```

Phase Four– AEM Mocks

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AEM Mocks - Introduction

- Natural extension of OSGi/JCR/Sling mocks to AEM
- Provides implementations for key components of AEM
  - PageManager, Page, Template
  - ComponentManager, Component
  - TagManager, Tag
  - Designer
  - ComponentContext, EditContext, EditConfig
  - Asset, Rendition

AEM Mocks – Test Example

```
public class AemAwareTest {

    @Rule public AemContext ctx = new AemContext();

    @Test public void workWithPages() throws WCMException {

        ctx.pageManager().
            create("/", "content", "/apps/my/templates/home", "Home");
        ctx.pageManager().
            create("/content", "welcome", "/apps/my/templates/hello", "Welcome");

        Iterator<Page> children = ctx.pageManager().getPage("/").listChildren();

        assertThat("Number of child pages for /", count(children), equalTo(1));
    }
}
```

AEM Mocks – Custom Setup Callback

```
private static final class SetUpCallback implements AemContextCallback {

    @Override
    public void execute(AemContext context) throws PersistenceException,
IOException {

        // application-specific services for unit tests
        context.registerService(CryptoSupport.class,
                                new MockCryptoSupport());
        context.registerService(Externalizer.class,
                                new MockExternalizer());

        // import sample content
        context.load().json("/sample-content.json", "/content/sample/en");

        // set default current page
        context.currentPage("/content/sample/en");
    }
}
```

AEM Mocks – Custom Setup Callback

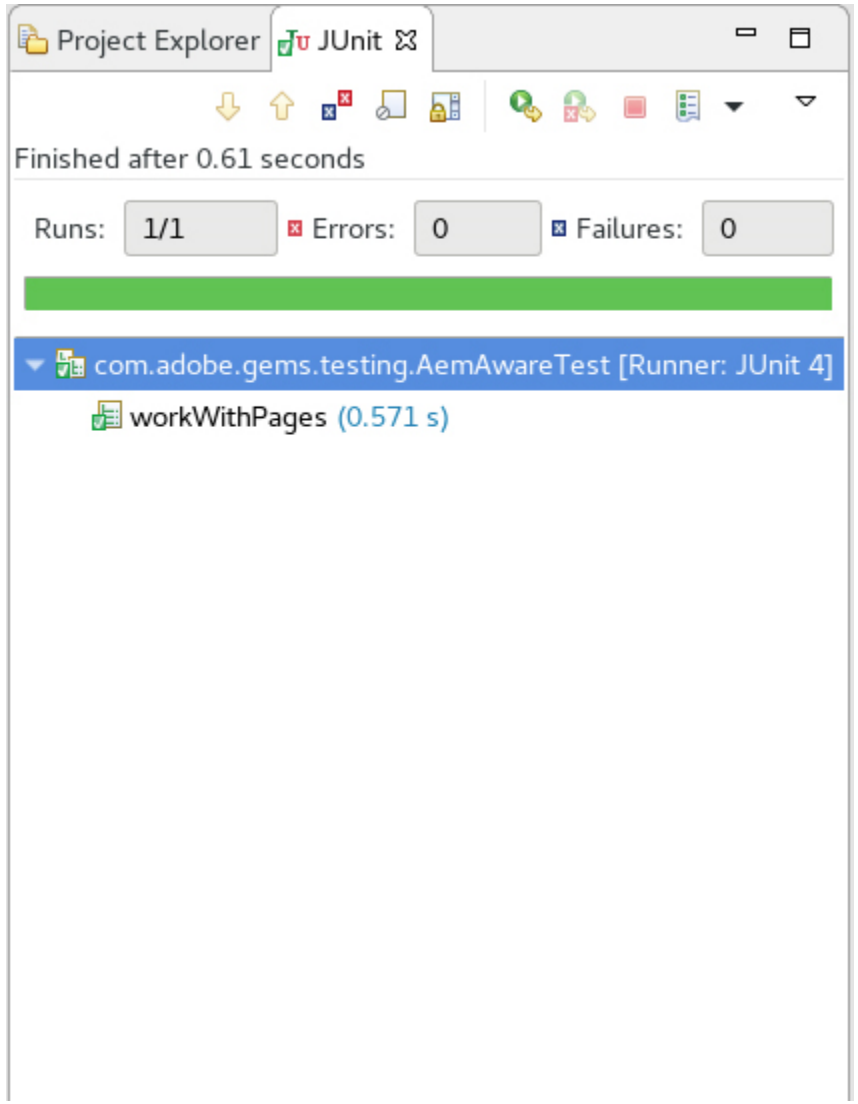
```
public class GemsAemContext {

    public static AemContext newAemContext() {
        return new AemContext(new SetUpCallback());
    }
}

public class AemAwareTest {

    @Rule public AemContext ctx = GemsAemContext.newAemContext();
    /* unchanged code omitted */
}
```

AEM Mocks – Execution Speed



Balance speed with mock implementation coverage

- Resource Resolver Mock (fastest)
- JCR Mock
- ~~JCR Jackrabbit~~
- JCR Oak (feature-complete JCR repository)

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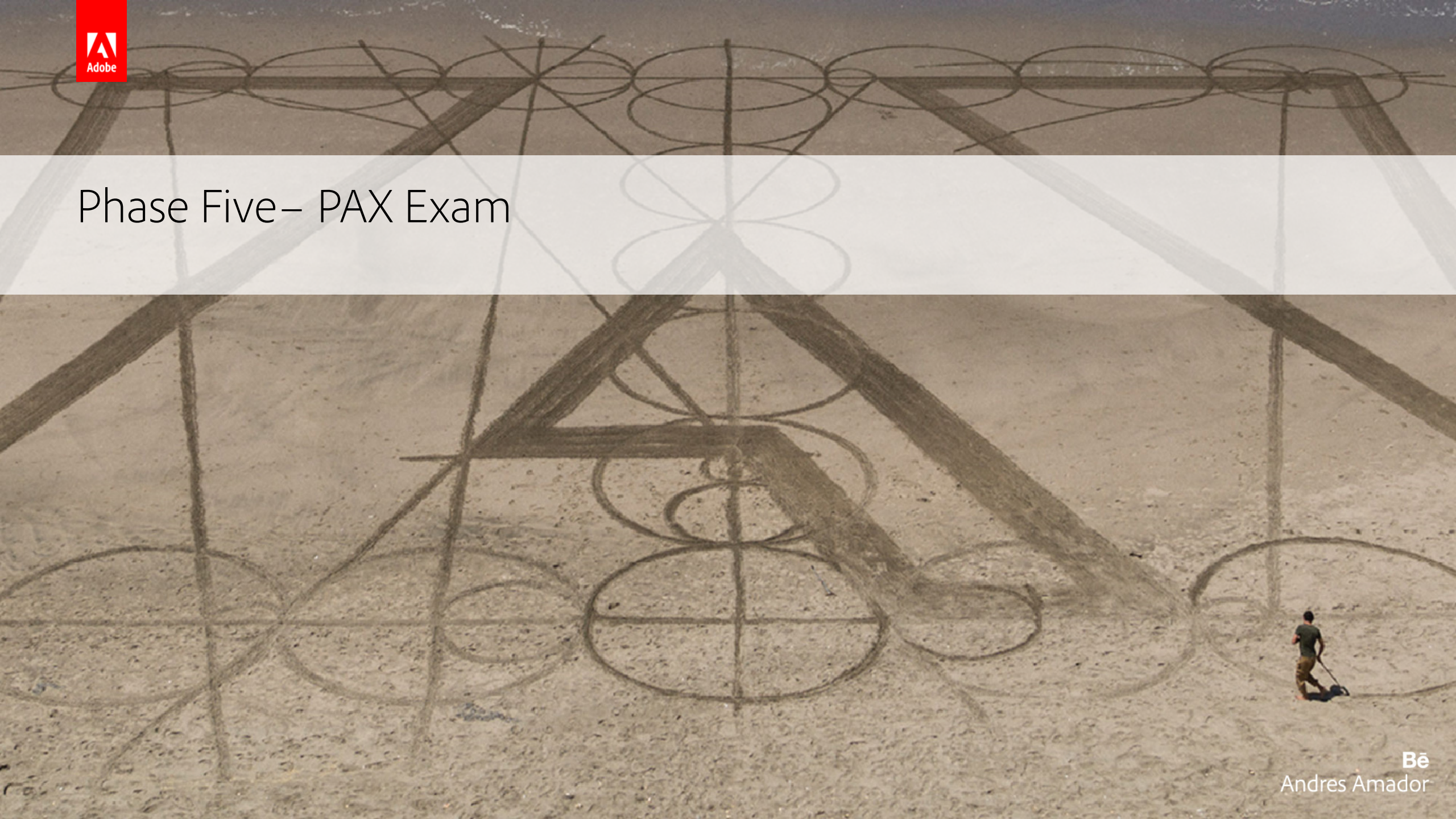
AEM Mocks – pom.xml snippet

```
<dependency>
    <groupId>io.wcm</groupId>
    <artifactId>io.wcm.testing.aem-mock</artifactId>
    <!-- for AEM 6.0 or 6.1 use version 1.x -->
    <version>2.1.0</version>
    <scope>test</scope>
</dependency>
```

Phase Five– PAX Exam



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OSGi Integration Testing with PAX Exam

- Launch a full OSGi application
  - **Framework**
  - **Bundles**
  - **Configurations**
- Run your test within that framework as a separate bundle

Simple Example with PAX

```
@RunWith(PaxExam.class)
public class SampleTest {

    @Inject
    private HelloService helloService;

    @Configuration
    public Option[] config() {
        return options(
            mavenBundle("com.example.myproject", "myproject-api", "1.0.0-SNAPSHOT"),
            junitBundles());
    }

    @Test
    public void getHelloService() {
        assertNotNull(helloService);
        assertEquals("Hello Pax!", helloService.getMessage());
    }
}
```


Source:https://ops4j1.jira.com/wiki/display/PAXEXAM4/Getting+Started+with+OSGi+Tests

Phase Six – End-to-end Tests

End-to-end Tests – general concepts

- Require one or more AEM instances to be started
- Slower, more difficult to write correctly
  - Slower hardware often reveals timing issues
  - Sensitive to environment changes
- Two variations supported by AEM
  - Black-box HTTP based via the Apache Sling Testing Clients and Rules
  - White-box testing via the Apache Sling Test Tools

Apache Sling Testing Clients and Rules

```
public class NewsletterCSVExportIT {

    @ClassRule
    public static SlingInstanceRule slingInstanceRule = new SlingInstanceRule();

    @Test
    public void csvExportContainsKnownUser() throws Exception {
    slingInstanceRule
        .getAdminClient()
        .doGet("/content/newsletter/subscribers.csv", HttpServletResponse.SC_OK)
        .checkContentContains("1,John Doe, john@doe.org");
    }
}
```

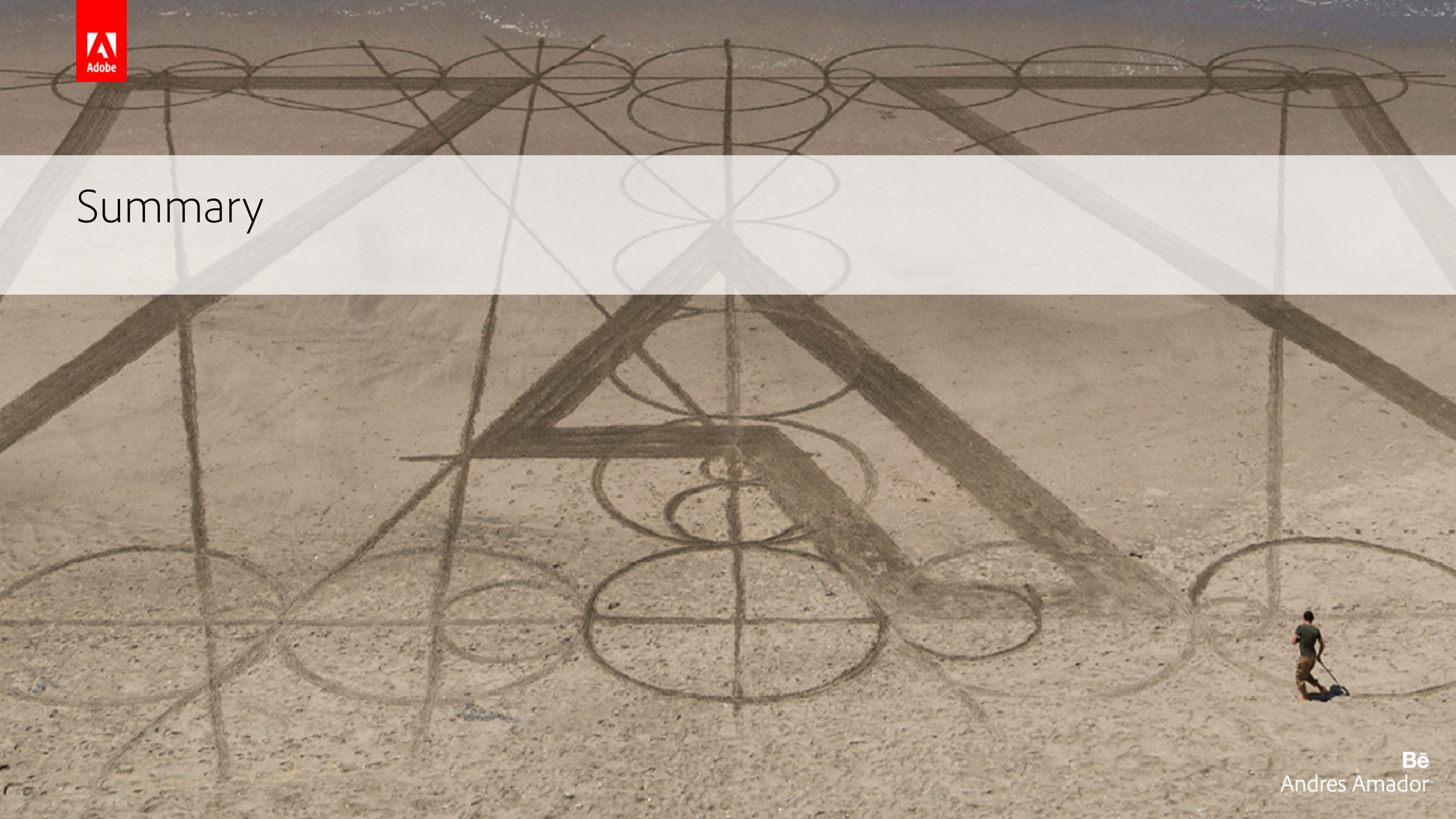
Apache Sling Testing Clients and Rules

```
public class AuditorTest {

    @Rule public final TeleporterRule teleporter = TeleporterRule.forClass(getClass(),
"Launchpad");

    @Test public void auditorHasNoEventsBeforePurge () throws IOException {

        final Auditor auditor = teleporter.getService(Auditor.class);
        assertNotNull(Auditor.class.getSimpleName(), auditor);
        assertThat("No purge events before action", auditor.getPurgeEventsCount(),
equalTo(0));
    }
}
```

Teleporter tests versus Pax-Exam

- Pax-Exam usually based on the „Bill of materials“ pattern
  - Lists all dependencies and assemble an OSGi runtime
- Teleporter tests are usually run against a full AEM instance
  - Dependencies are pulled in via a certain AEM version – for instance AEM 6.2
- Rules of the thumb
  - Prefer Pax-Exam tests for libraries which have a few well-defined dependencies
  - Prefer Teleporter tests for applications which should run on a certain AEM release

Summary



Fast and early testing

- Unit tests
- Mocking
- Special mock libraries
- Integration testing

Links

- Maven: https://maven.apache.org
- JUnit: http://junit.org/junit4/
- Mockito: http://site.mockito.org
- Apache Sling Mocks:
  - https://sling.apache.org/documentation/development/resourceresolver-mock.html
  - https://sling.apache.org/documentation/development/sling-mock.html
  - https://sling.apache.org/documentation/development/osgi-mock.html
  - https://sling.apache.org/documentation/development/jcr-mock.html

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