OSGi Working Group

OSGi Compendium

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OSGi®

Preface

Implementation Requirements

An implementation of a Specification: (i) must fully implement the Specification including all its required interfaces and functionality; (ii) must not modify, subset, superset or otherwise extend the OSGi Name Space, or include any public or protected packages, classes, Java interfaces, fields or methods within the OSGi Name Space other than those required and authorized by the Specification. An implementation that does not satisfy limitations (i)-(ii) is not considered an implementation of the Specification and must not be described as an implementation of the Specification. "OSGi Name Space" shall mean the public class or interface declarations whose names begin with "org.osgi" or any recognized successors or replacements thereof. An implementation of a Specification must not claim to be a compatible implementation of the Specification unless it passes the Technology Compatibility Kit ("TCK") for the Specification.

Feedback

This specification can be downloaded from the OSGi Documentation web site:

`https://docs.osgi.org/specification/`

Comments about this specification can be raised at:

`https://github.com/osgi/osgi/issues`

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159 Feature Service Specification

Version 1.0

159.1 Introduction

OSGi has become a platform capable of running large applications for a variety of purposes, including rich client applications, server-side systems and cloud and container based architectures. As these applications are generally based on many bundles, describing each bundle individually in an application definition becomes unwieldy once the number of bundles reaches a certain level.

When developing large scale applications it is often the case that few people know the role of every single bundle or configuration item in the application. To keep the architecture understandable a grouping mechanism is needed that allows for the representation of parts of the application into larger entities that keep reasoning about the system manageable. In such a domain members of teams spread across an organization will need to be able to both develop new parts for the application as well as make tweaks or enhancements to parts developed by others such as adding configuration and resources or changing one or more bundles relevant to their part of the application.

The higher level constructs that define the application should be reusable in different contexts, for example if one team has developed a component to handle job processing, different applications should be able to use it, and if needed tune its configuration or other aspects so that it works in each setting without having to know each and every detail that the job processing component is built up from.

Applications are often associated with additional resources or metadata, for example database scripts or custom artifacts. By including these with the application definition, all the related entities are encapsulated in a single artifact.

By combining various applications or subsystems together, systems are composed of existing, reusable building blocks, where all these blocks can work together. Architects of these systems need to think about components without having to dive into the individual implementation details of each subcomponent. The Features defined in this specification can be used to model such applications. Features contain the definition of an application or component and may be composed into larger systems.

159.1.1 Essentials

- *Declarative* - Features are declarative and can be mapped to different implementations.
- *Extensible* - Features are extensible with custom content to facilitate all information related to a Feature to be co-located.
- *Human Readable* - No special software is needed to read or author Features.
- *Machine Readable* - Features are easily be processed by tools.

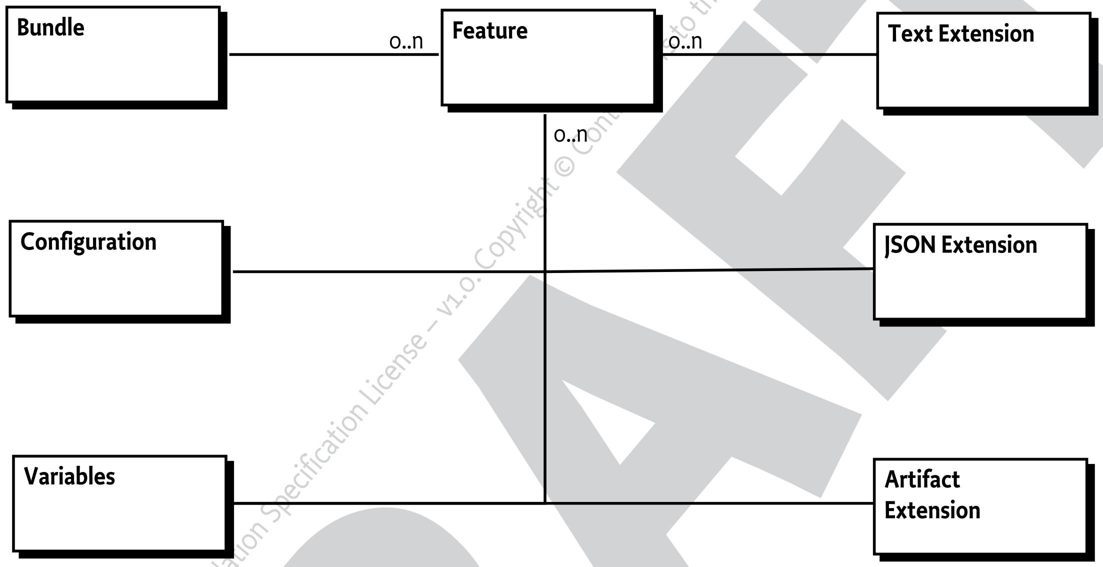
159.1.2 Entities

The following entities are used in this specification:

- *Feature* - A Feature contains a number of entities that, when provided to a launcher can be turned into an executable system. Features are building blocks which may be assembled into larger systems.

- *Bundles* - A Feature can contain one ore more bundles.
- *Configuration* - A Feature can contain configurations for the Configuration Admin service.
- *Extension* - A Feature can contain a number of extensions with custom content.
- *Launcher* - A launcher turns one or more Features into an executable system.
- *Processor* - A Feature processor reads Features and perform a processing operation on them, such as validation, transformation or generation of new entities based on the Features.
- *Properties* - Framework launching properties can be specified in a Feature.

Figure 159.1 *Features Entity overview*



159.2 Feature

Features are defined by declaring JSON documents or by using the Feature API. Each Feature has a unique ID which includes a version. It holds a number of entities, including a list of bundles, configurations and others. Features are extensible, that is a Feature can also contain any number of custom entities which are related to the Feature.

Features may have dependencies on other Features. Features inherit the capabilities and requirements from all bundles listed in the Feature.

Once created, a Feature is immutable. Its definition cannot be modified. However it is possible to record caching related information in a Feature through transient extensions. This cached content is not significant for the definition of the Feature or part of its identity.

159.2.1 Identifiers

Identifiers used throughout this specification are defined using the Maven Identifier model. They are composed of the following parts:

- Group ID
- Artifact ID
- Version
- Type (optional)

- Classifier (optional)

Note that if Version has the -SNAPSHOT suffix, the identifier points at an unreleased artifact that is under development and may still change.

For more information see [3] *Apache Maven Pom Reference*. The format used to specify identifiers is as follows:

```
groupId ':' artifactId ( ':' type ( ':' classifier )? )? ':' version
```

159.2.2 Feature Identifier

Each Feature has a unique identifier. Apart from providing a persistent handle to the Feature, it also provides enough information to find the Feature in an artifact repository. This identifier is defined using the format described in *Identifiers* on page 6.

159.2.2.1 Identifier type

Features use as identifier type the value osgifeature.

159.2.3 Attributes

A Feature can have the following attributes:

Table 159.1 *Feature Attributes*

Attribute	Data Type	Kind	Description
name	String	Optional	The short descriptive name of the Feature.
categories	Array of String	Optional, defaults to an empty array	The categories this Feature belongs to. The values are user-defined.
complete	boolean	Optional, defaults to false	Completeness of the Feature. A Feature is complete when it has no external dependencies.
description	String	Optional	A longer description of the Feature.
docURL	String	Optional	A location where documentation can be found for the Feature.
license	String	Optional	The license of the Feature. The license only relates to the Feature itself and not to any artifacts that might be referenced by the Feature. The license follows the Bundle-License format as specified in the Core specification.
SCM	String	Optional	SCM information relating to the feature. The syntax of the value follows the Bundle-SCM format. See the 'Bundle Manifest Headers' section in the OSGi Core specification.
vendor	String	Optional	The vendor of the Feature.

An initial Feature without content can be declared as follows:

```
{
  "feature-resource-version": "1.0",
  "id": "org.acme:acmeapp:1.0.0",

  "name": "The ACME app",
  "description":
    "This is the main ACME app, from where all functionality is reached."

  /*
    Additional Feature entities here
    ...
  */
}
```

159.2.4 Using the Feature API

Features can also be created, read and written using the Feature API. The main entry point for this API is the FeatureService. The Feature API uses the builder pattern to create entities used in Features.

A builder instance is used to create a single entity and cannot be re-used to create a second one. Builders are created from the BuilderFactory, which is available from the FeatureService through getBuilderFactory().

```
FeatureService fs = ... // from Service Registry
BuilderFactory factory = fs.getBuilderFactory();

FeatureBuilder builder = factory.newFeatureBuilder(
  fs.getID("org.acme", "acmeapp", "1.0.0"));
builder.setName("The ACME app");
builder.setDescription("This is the main ACME app, "
  + "from where all functionality is reached.");

Feature f = builder.build();
```

The Feature API can also be useful in environments outside of an OSGi Framework where no service registry is available, for example in a build-system environment. In such environments the FeatureService can be obtained by using the java.util.ServiceLoader mechanism.

159.3 Comments

Comments in the form of [2] *JSMin (The JavaScript Minifier)* comments are supported, that is, any text on the same line after // is ignored and any text between /* */ is ignored.

159.4 Bundles

Features list zero or more bundles that implement the functionality provided by the Feature. Bundles are listed by referencing them in the bundles array so that they can be resolved from a repository. Bundles can have metadata associated with them, such as the relative start order of the bundle in the Feature. Custom metadata may also be provided. A single Feature can provide multiple versions of the same bundle, if desired.

Bundles are referenced using the identifier format described in *Identifiers* on page 6. This means that Bundles are referenced using their Maven coordinates. The bundles array contains JSON objects which can contain the bundle IDs and specify optional additional metadata.

159.4.1 Bundle Metadata

Arbitrary key-value pairs can be associated with bundle entries to store custom metadata alongside the bundle references. Reverse DNS naming should be used with the keys to avoid name clashes when metadata is provided by multiple entities. Keys not using the reverse DNS naming scheme are reserved for OSGi use.

Bundle metadata supports string keys and string, number or boolean values.

The following example shows a simple Feature describing a small application with its dependencies:

```
{
  "feature-resource-version": "1.0",
  "id": "org.acme:acmeapp:1.0.1",

  "name": "The Acme Application",
  "license": "https://opensource.org/licenses/Apache-2.0",
  "complete": true,

  "bundles": [
    { "id": "org.osgi:org.osgi.util.function:1.1.0" },
    { "id": "org.osgi:org.osgi.util.promise:1.1.1" },
    {
      "id": "org.apache.commons:commons-email:1.5",

      // This attribute is used by custom tooling to
      // find the associated javadoc
      "org.acme.javadoc.link":
        "https://commons.apache.org/proper/commons-email/javadocs/api-1.5"
    },
    { "id": "com.acme:acmelib:1.7.2" }
  ]

  /*
    Additional Feature entities here
    ...
  */
}
```

159.4.2 Using the Feature API

A Feature with Bundles can be created using the Feature API as follows:

```
FeatureService fs = ... // from Service Registry
BuilderFactory factory = fs.getBuilderFactory();

FeatureBuilder builder = factory.newFeatureBuilder(
  fs.getID("org.acme", "acmeapp", "1.0.1"));
builder.setName("The Acme Application");
builder.setLicense("https://opensource.org/licenses/Apache-2.0");
builder.setComplete(true);

FeatureBundle b1 = factory
  .newBundleBuilder(fs.getIDfromMavenCoordinates(
    "org.osgi:org.osgi.util.function:1.1.0"))
  .build();
FeatureBundle b2 = factory
  .newBundleBuilder(fs.getIDfromMavenCoordinates(
    "org.osgi:org.osgi.util.promise:1.1.1"))
  .build();
```

```
FeatureBundle b3 = factory
  .newBundleBuilder(fs.getIDfromMavenCoordinates(
    "org.apache.commons:commons-email:1.1.5"))
  .addMetadata("org.acme.javadoc.link",
    "https://commons.apache.org/proper/commons-email/javadocs/api-1.5")
  .build();
FeatureBundle b4 = factory
  .newBundleBuilder(fs.getIDfromMavenCoordinates(
    "com.acme:acmelib:1.7.2"))
  .build();

builder.addBundles(b1, b2, b3, b4);
Feature f = builder.build();
```

159.5 Configurations

Features support configuration using the OSGi Configurator syntax, see ???. This is specified with the configurations key in the Feature. A Launcher can apply these configurations to the Configuration Admin service when starting the system.

It is an error to define the same PID twice in a single Feature. An entity processing the feature must fail in this case.

Example:

```
{
    "feature-resource-version": "1.0",
    "id": "org.acme:acmeapp:osgifeature:configs:1.0.0",
    "configurations": {
        "org.apache.felix.http": {
            "org.osgi.service.http.port": 8080,
            "org.osgi.service.http.port.secure": 8443
        }
    }
}
```

159.6 Variables

Configurations and Framework Launching Properties support late binding of values. This enables setting these items through a Launcher, for example to specify a database user name, server port number or other information that may be variable between runtimes.

Variables are declared in the variables section of the Feature and they can have a default value specified. The default must be of type string, number or boolean. Variables can also be declared to *not* have a default, which means that they must be provided with a value through the Launcher. This is done by specifying null as the default in the variable declaration.

Example:

```
{
    "feature-resource-version": "1.0",
    "id": "org.acme:acmeapp:osgifeature:configs:1.1.0",
    "variables": {
        "http.port": 8080,
        "db.username": "scott",
        "db.password": null
    },
    "configurations": {
        "org.acme.server.http": {
            "org.osgi.service.http.port:Integer": "${http.port}"
        },
        "org.acme.db": {
            "username": "${db.username}-user",
            "password": "${db.password}"
        }
    }
}
```

Variables are referenced with the curly brace placeholder syntax: `${ variable-name }` in the configuration value or framework launching property value section. To support conversion of variables to non-string types the configurator syntax specifying the datatype with the configuration key is used, as in the above example.

Multiple variables can be referenced for a single configuration or framework launching property value and variables may be combined with text. If no variable exist with the given name, then the `${ variable-name }` must be retained in the value.

159.7 Extensions

Features can include custom content. This makes it possible to keep custom entities and information relating to the Feature together with the rest of the Feature.

Custom content is provided through Feature extensions, which are in one of the following formats:

- *Text* - A text extension contains an array of text.
- *JSON* - A JSON extension contains embedded custom JSON content.
- *Artifacts* - A list of custom artifacts associated with the Feature.

Extensions can have a variety of consumers. For example they may be handled by a Feature Launcher or by an external tool which can process the extension at any point of the Feature life cycle.

Extensions are of one of the following three kinds:

- *Mandatory* - The entity processing this Feature *must* know how to handle this extension. If it cannot handle the extension it must fail.
- *Optional* - This extension is optional. If the entity processing the Feature cannot handle it, the extension can be skipped or ignored. This is the default.
- *Transient* - This extension contains transient information which may be used to optimize the processing of the Feature. It is not part of the Feature definition.

Extensions are specified as JSON objects under the `extensions` key in the Feature. A Feature can contain any number of extensions, as long as the extension keys are unique. Extension keys should use reverse domain naming to avoid name clashing of multiple extensions in a single Feature. Extensions names without a reverse domain naming prefix are reserved for OSGi use.

159.7.1 Text Extensions

Text extensions support the addition of custom text content to the Feature. The text is provided as a JSON array of strings.

Example:

```
{
    "feature-resource-version": "1.0",
    "id": "org.acme:acmeapp:2.0.0",

    "name": "The Acme Application",
    "license": "https://opensource.org/licenses/Apache-2.0",

    "extensions": {
        "org.acme.mydoc": {
            "type": "text",
            "text": [
                "This application provides the main acme ",
                "functionality."
            ]
        }
    }
}
```

159.7.2 JSON Extensions

Custom JSON content is added to Features by using a JSON extension. The content can either be a JSON object or a JSON array.

The following example extension declares under which execution environment the Feature is complete, using a custom JSON object.

```
{
    "feature-resource-version": "1.0",
    "id": "org.acme:acmeapp:2.1.0",

    "name": "The Acme Application",
    "license": "https://opensource.org/licenses/Apache-2.0",

    "extensions": {
        "org.acme.execution-environment": {
            "type": "json",
            "json": {
                "environment-capabilities":
                    ["osgi.ee; filter:=\"(&(osgi.ee=JavaSE)(version=11))\""],
                "framework": "org.osgi:core:6.0.0",
                "provided-features": ["org.acme:platform:1.1"]
            }
        }
    }
}
```

159.7.3 Artifact list Extensions

Custom extensions can be used to associate artifacts that are not listed as bundles with the Feature.

For example, database definition resources may be listed as artifacts in a Feature. In the following example, the extension org.acme.ddlfiles lists Database Definition Resources which *must* be handled by the launcher agent, that is, the database must be configured when the application is run:

```
{
    "feature-resource-version": "1.0",
    "id": "org.acme:acmeapp:2.2.0",
    "name": "The Acme Application",
    "license": "https://opensource.org/licenses/Apache-2.0",
    "complete": true,

    "bundles": [
        "org.osgi:org.osgi.util.function:1.1.0",
        "org.osgi:org.osgi.util.promise:1.1.1",
        "com.acme:acmelib:2.0.0"
    ],

    "extensions": {
        "org.acme.ddlfiles": {
            "kind": "mandatory",
            "type": "artifacts",
            "artifacts": [
              { "id": "org.acme:appddl:1.2.1" },
              {
                "id": "org.acme:appddl-custom:1.0.3",
                "org.acme.target": "custom-db"
              }
           ]
        }
    }
}
```

As with bundle identifiers, custom artifacts are specified in an object in the artifacts list with an explicit id and optional additional metadata. The keys of the metadata should use a reverse domain naming pattern to avoid clashes. Keys that do not use reverse domain name as a prefix are reserved for OSGi use. Supported metadata values must be of type string, number or boolean.

159.8 Framework Launching Properties

When a Feature is launched in an OSGi framework it may be necessary to specify Framework Properties. These are provided in the Framework Launching Properties extension section of the Feature. The Launcher must be able to satisfy the specified properties. If it cannot ensure that these are present in the running Framework the launcher must fail.

Framework Launching Properties can reference Variables as defined in *Variables* on page 10. These variables are substituted before the properties are set.

Example:

```
{
  "feature-resource-version": "1.0",
  "id": "org.acme:acmeapp:osgifeature:fw-props:2.0.0",

  "variables": {
    "fw.storage.dir": "/tmp" // Can be overridden through the launcher
  },

  "extensions": {
    "framework-launching-properties": {
      "type": "json",
      "json": {
          "org.osgi.framework.system.packages.extra":
            "javax.activation;version=\"1.1.1\"",
          "org.osgi.framework.bootdelegation": "javax.activation",
          "org.osgi.framework.storage": "${fw.storage.dir}"
      }
    }
  }
}
```

159.9 Resource Versioning

Feature JSON resources are versioned to support updates to the JSON structure in the future. To declare the document version of the Feature use the feature-resource-version key in the JSON document.

```
{
  "feature-resource-version": "1.0",
  "id": "org.acme:acmeapp:1.0.0"

  /*
    Additional Feature entities here
    ...
  */
}
```

The currently supported version of the Feature JSON documents is 1.0. If no Feature Resource Version is specified 1.0 is used as the default.

159.10 Capabilities

159.10.1 osgi.service Capability

The bundle providing the Feature Service must provide a capability in the osgi.service namespace representing the services it is registering. This capability must also declare uses constraints for the relevant service packages:

```
Provide-Capability: osgi.service;
  objectClass:List<String>="org.osgi.service.feature.FeatureService";
  uses:="org.osgi.service.feature"
```

This capability must follow the rules defined for the ???.

159.11 org.osgi.service.feature

Feature Package Version 1.0.

Bundles wishing to use this package must list the package in the Import-Package header of the bundle's manifest. This package has two types of users: the consumers that use the API in this package and the providers that implement the API in this package.

Example import for consumers using the API in this package:

```
Import-Package: org.osgi.service.feature; version="[1.0,2.0)"
```

Example import for providers implementing the API in this package:

```
Import-Package: org.osgi.service.feature; version="[1.0,1.1)"
```

159.11.1 Summary

- `BuilderFactory` - The Builder Factory can be used to obtain builders for the various entities.
- `Feature` - The Feature Model Feature.
- `FeatureArtifact` - An Artifact is an entity with an ID, for use in extensions.
- `FeatureArtifactBuilder` - A builder for FeatureArtifact objects.
- `FeatureBuilder` - A builder for Feature Models.
- `FeatureBundle` - A Bundle which is part of a feature.
- `FeatureBundleBuilder` - A builder for Feature Model FeatureBundle objects.
- `FeatureConfiguration` - Represents an OSGi Configuration in the Feature Model.
- `FeatureConfigurationBuilder` - A builder for Feature Model FeatureConfiguration objects.
- `FeatureConstants` - Defines standard constants for the Feature specification.
- `FeatureExtension` - A Feature Model Extension.
- `FeatureExtension.Kind` - The kind of extension: optional, mandatory or transient.
- `FeatureExtension.Type` - The type of extension
- `FeatureExtensionBuilder` - A builder for Feature Model FeatureExtension objects.
- `FeatureService` - The Feature service is the primary entry point for interacting with the feature model.
- `ID` - ID used to denote an artifact.

159.11.2 public interface BuilderFactory

The Builder Factory can be used to obtain builders for the various entities.

Provider Type Consumers of this API must not implement this type

159.11.2.1 public FeatureArtifactBuilder newArtifactBuilder(ID id)

id The artifact ID for the artifact object being built.

□ Obtain a new builder for Artifact objects.

Returns The builder.

159.11.2.2 public FeatureBundleBuilder newBundleBuilder(ID id)

id The ID for the bundle object being built. If the ID has no type specified, a default type of @{code jar} is assumed.

□ Obtain a new builder for Bundle objects.

Returns The builder.

159.11.2.3 public FeatureConfigurationBuilder newConfigurationBuilder(String pid)

pid The persistent ID for the Configuration being built.

□ Obtain a new builder for Configuration objects.

Returns The builder.

159.11.2.4 public FeatureConfigurationBuilder newConfigurationBuilder(String factoryPid, String name)

factoryPid The factory persistent ID for the Configuration being built.

name The name of the configuration being built. The PID for the configuration will be the factoryPid + '~' + name

□ Obtain a new builder for Factory Configuration objects.

Returns The builder.

159.11.2.5 public FeatureExtensionBuilder newExtensionBuilder(String name, FeatureExtension.Type type, FeatureExtension.Kind kind)

name The extension name.

type The type of extension: JSON, Text or Artifacts.

kind The kind of extension: Mandatory, Optional or Transient.

□ Obtain a new builder for Feature objects.

Returns The builder.

159.11.2.6 public FeatureBuilder newFeatureBuilder(ID id)

id The ID for the feature object being built. If the ID has no `type` specified, a default type of `osgifeature` is assumed.

□ Obtain a new builder for Feature objects.

Returns The builder.

159.11.3 public interface Feature

The Feature Model Feature.

Concurrency Thread-safe

Provider Type Consumers of this API must not implement this type

159.11.3.1 public List<FeatureBundle> getBundles()

□ Get the bundles.

Returns The bundles. The returned list is unmodifiable.

159.11.3.2 public List<String> getCategories()

□ Get the categories.

Returns The categories. The returned list is unmodifiable.

159.11.3.3 public Map<String, FeatureConfiguration> getConfigurations()

□ Get the configurations. The iteration order of the returned map should follow the definition order of the configurations in the feature.

Returns The configurations. The returned map is unmodifiable.

159.11.3.4 public Optional<String> getDescription()

□ Get the description.

Returns The description.

159.11.3.5 public Optional<String> getDocURL()

□ Get the documentation URL.

Returns The documentation URL.

159.11.3.6 public Map<String, FeatureExtension> getExtensions()

□ Get the extensions. The iteration order of the returned map should follow the definition order of the extensions in the feature.

Returns The extensions. The returned map is unmodifiable.

159.11.3.7 public ID getID()

□ Get the Feature's ID.

Returns The ID of this Feature.

159.11.3.8 public Optional<String> getLicense()

□ Get the license of this Feature. The syntax of the value follows the Bundle-License header syntax. See the 'Bundle Manifest Headers' section in the OSGi Core specification.

Returns The license.

159.11.3.9 public Optional<String> getName()

□ Get the name.

Returns The name.

159.11.3.10 public Optional<String> getSCM()

□ Get the SCM information relating to the feature. The syntax of the value follows the Bundle-SCM format. See the 'Bundle Manifest Headers' section in the OSGi Core specification.

Returns The SCM information.

159.11.3.11 public Map<String, Object> getVariables()

□ Get the variables. The iteration order of the returned map should follow the definition order of the variables in the feature. Values are of type: String, Boolean or BigDecimal for numbers. The null JSON value is represented by a null value in the map.

Returns The variables. The returned map is unmodifiable.

159.11.3.12 public Optional<String> getVendor()

□ Get the vendor.

Returns The vendor.

159.11.3.13 public boolean isComplete()

□ Get whether the feature is complete or not.

Returns Completeness value.

159.11.4 public interface FeatureArtifact

An Artifact is an entity with an ID, for use in extensions.

Concurrency Thread-safe

Provider Type Consumers of this API must not implement this type

159.11.4.1 public ID getID()

□ Get the artifact's ID.

Returns The ID of this artifact.

159.11.4.2 public Map<String, Object> getMetadata()

□ Get the metadata for this artifact.

Returns The metadata. The returned map is unmodifiable.

159.11.5 public interface FeatureArtifactBuilder

A builder for FeatureArtifact objects.

Concurrency Not Thread-safe

Provider Type Consumers of this API must not implement this type

159.11.5.1 public FeatureArtifactBuilder addMetadata(String key, Object value)

key Metadata key.

value Metadata value.

□ Add metadata for this Artifact.

Returns This builder.

159.11.5.2 public FeatureArtifactBuilder addMetadata(Map<String, Object> metadata)

metadata The map with metadata.

□ Add metadata for this Artifact by providing a map. All metadata in the map is added to any previously provided metadata.

Returns This builder.

159.11.5.3 public FeatureArtifact build()

□ Build the Artifact object. Can only be called once on a builder. After calling this method the current builder instance cannot be used any more.

Returns The Feature Artifact.

159.11.6 public interface FeatureBuilder

A builder for Feature Models.

Concurrency Not Thread-safe

Provider Type Consumers of this API must not implement this type

159.11.6.1 public FeatureBuilder addBundles(FeatureBundle... bundles)

bundles The Bundles to add.

□ Add Bundles to the Feature.

Returns This builder.

159.11.6.2 public FeatureBuilder addCategories(String... categories)

categories The Categories.

□ Adds one or more categories to the Feature.

Returns This builder.

159.11.6.3 public FeatureBuilder addConfigurations(FeatureConfiguration... configs)

configs The Configurations to add.

□ Add Configurations to the Feature.

Returns This builder.

159.11.6.4 public FeatureBuilder addExtensions(FeatureExtension... extensions)

extensions The Extensions to add.

□ Add Extensions to the Feature

Returns This builder.

159.11.6.5 public FeatureBuilder addVariable(String key, Object defaultValue)

key The key.

defaultValue The default value.

□ Add a variable to the Feature. If a variable with the specified key already exists it is replaced with this one. Variable values are of type: String, Boolean or BigDecimal for numbers.

Returns This builder.

Throws IllegalArgumentException– if the value is of an invalid type.

159.11.6.6 public FeatureBuilder addVariables(Map<String, Object> variables)

variables to be added.

□ Add a map of variables to the Feature. Pre-existing variables with the same key in are overwritten if these keys exist in the map. Variable values are of type: String, Boolean or BigDecimal for numbers.

Returns This builder.

Throws IllegalArgumentException– if a value is of an invalid type.

159.11.6.7 public Feature build()

□ Build the Feature. Can only be called once on a builder. After calling this method the current builder instance cannot be used any more.

Returns The Feature.

159.11.6.8 public FeatureBuilder setComplete(boolean complete)

complete If the feature is complete.

□ Set the Feature Complete flag. If this method is not called the complete flag defaults to false.

Returns This builder.

159.11.6.9 public FeatureBuilder setDescription(String description)

description The description.

□ Set the Feature Description.

Returns This builder.

159.11.6.10 public FeatureBuilder setDocURL(String docURL)

docURL The Documentation URL.

□ Set the documentation URL.

Returns This builder.

159.11.6.11 public FeatureBuilder setLicense(String license)

license The License.

□ Set the License.

Returns This builder.

159.11.6.12 public FeatureBuilder setName(String name)

name The Name.

□ Set the Feature Name.

Returns This builder.

159.11.6.13 public FeatureBuilder setSCM(String scm)

scm The SCM information.

□ Set the SCM information.

Returns This builder.

159.11.6.14 public FeatureBuilder setVendor(String vendor)

vendor The Vendor.

□ Set the Vendor.

Returns This builder.

159.11.7 public interface FeatureBundle

A Bundle which is part of a feature.

Concurrency Thread-safe

Provider Type Consumers of this API must not implement this type

159.11.7.1 public ID getID()

□ Get the bundle's ID.

Returns The ID of this bundle.

159.11.7.2 public Map<String, Object> getMetadata()

□ Get the metadata for this bundle.

Returns The metadata. The returned map is unmodifiable.

159.11.8 public interface FeatureBundleBuilder

A builder for Feature Model FeatureBundle objects.

Concurrency Not Thread-safe

Provider Type Consumers of this API must not implement this type

159.11.8.1 public FeatureBundleBuilder addMetadata(String key, Object value)

key Metadata key.

value Metadata value.

□ Add metadata for this Bundle.

Returns This builder.

159.11.8.2 public FeatureBundleBuilder addMetadata(Map<String, Object> metadata)

metadata The map with metadata.

□ Add metadata for this Bundle by providing a map. All metadata in the map is added to any previously provided metadata.

Returns This builder.

159.11.8.3 public FeatureBundle build()

□ Build the Bundle object. Can only be called once on a builder. After calling this method the current builder instance cannot be used any more.

Returns The Bundle.

159.11.9 public interface FeatureConfiguration

Represents an OSGi Configuration in the Feature Model.

Concurrency Thread-safe

Provider Type Consumers of this API must not implement this type

159.11.9.1 public Optional<String> getFactoryPid()

□ Get the Factory PID from the configuration, if any.

Returns The Factory PID, or `null` if there is none.

159.11.9.2 public String getPid()

□ Get the PID from the configuration.

Returns The PID.

159.11.9.3 public Map<String, Object> getValues()

□ Get the configuration key-value map.

Returns The key-value map. The returned map is unmodifiable.

159.11.10 public interface FeatureConfigurationBuilder

A builder for Feature Model FeatureConfiguration objects.

Concurrency Not Thread-safe

Provider Type Consumers of this API must not implement this type

159.11.10.1 public FeatureConfigurationBuilder addValue(String key, Object value)

key The configuration key.

value The configuration value. Acceptable data types are the data type supported by the Configuration Admin service, which are the Primary Property Types as defined for the Filter Syntax in the OSGi Core specification.

□ Add a configuration value for this Configuration object. If a value with the same key was previously provided (regardless of case) the previous value is overwritten.

Returns This builder.

Throws `IllegalArgumentException`– if the value is of an invalid type.

159.11.10.2 public FeatureConfigurationBuilder addValues(Map<String, Object> configValues)

configValues The map of configuration values to add. Acceptable value types are the data type supported by the Configuration Admin service, which are the Primary Property Types as defined for the Filter Syntax in the OSGi Core specification.

□ Add a map of configuration values for this Configuration object. Values will be added to any previously provided configuration values. If a value with the same key was previously provided (regardless of case) the previous value is overwritten.

Returns This builder.

Throws `IllegalArgumentException`– if a value is of an invalid type or if the same key is provided in different capitalizations (regardless of case).

159.11.10.3 public FeatureConfiguration build()

□ Build the Configuration object. Can only be called once on a builder. After calling this method the current builder instance cannot be used any more.

Returns The Configuration.

159.11.11 public final class FeatureConstants

Defines standard constants for the Feature specification.

159.11.11.1 public static final String FEATURE_IMPLEMENTATION = "osgi.feature"

The name of the implementation capability for the Feature specification.

159.11.11.2 public static final String FEATURE_SPECIFICATION_VERSION = "1.0"

The version of the implementation capability for the Feature specification.

159.11.12 public interface FeatureExtension

A Feature Model Extension. Extensions can contain either Text, JSON or a list of Artifacts.

Extensions are of one of the following kinds:

- Mandatory: this extension must be processed by the runtime
- Optional: this extension does not have to be processed by the runtime
- Transient: this extension contains transient information such as caching data that is for optimization purposes. It may be changed or removed and is not part of the feature's identity.

Concurrency Thread-safe

Provider Type Consumers of this API must not implement this type

159.11.12.1 public List<FeatureArtifact> getArtifacts()

□ Get the Artifacts from this extension.

Returns The Artifacts. The returned list is unmodifiable.

Throws IllegalStateException– If called on an extension which is not of type ARTIFACTS.

159.11.12.2 public String getJSON()

□ Get the JSON from this extension.

Returns The JSON.

Throws IllegalStateException– If called on an extension which is not of type JSON.

159.11.12.3 public FeatureExtension.Kind getKind()

□ Get the extension kind.

Returns The kind.

159.11.12.4 public String getName()

□ Get the extension name.

Returns The name.

159.11.12.5 public List<String> getText()

□ Get the Text from this extension.

Returns The lines of text. The returned list is unmodifiable.

Throws IllegalStateException– If called on an extension which is not of type TEXT.

159.11.12.6 public FeatureExtension.Type getType()

□ Get the extension type.

Returns The type.

159.11.13 enum FeatureExtension.Kind

The kind of extension: optional, mandatory or transient.

159.11.13.1 MANDATORY

A mandatory extension must be processed.

159.11.13.2 OPTIONAL

An optional extension can be ignored if no processor is found.

159.11.13.3 TRANSIENT

A transient extension contains computed information which can be used as a cache to speed up operation.

159.11.13.4 public static FeatureExtension.Kind valueOf(String name)

159.11.13.5 public static FeatureExtension.Kind[] values()

159.11.14 enum FeatureExtension.Type

The type of extension

159.11.14.1 JSON

A JSON extension.

159.11.14.2 TEXT

A plain text extension.

159.11.14.3 ARTIFACTS

An extension that is a list of artifact identifiers.

159.11.14.4 public static FeatureExtension.Type valueOf(String name)

159.11.14.5 public static FeatureExtension.Type[] values()

159.11.15 public interface FeatureExtensionBuilder

A builder for Feature Model FeatureExtension objects.

Concurrency Not Thread-safe

Provider Type Consumers of this API must not implement this type

159.11.15.1 public FeatureExtensionBuilder addArtifact(FeatureArtifact artifact)

artifact The artifact to add.

□ Add an Artifact to the extension. Can only be called for extensions of type FeatureExtension.Type.ARTIFACTS.

Returns This builder.

159.11.15.2 public FeatureExtensionBuilder addText(String text)

text The text to be added.

□ Add a line of text to the extension. Can only be called for extensions of type FeatureExtension.Type.TEXT.

Returns This builder.

159.11.15.3 public FeatureExtension build()

□ Build the Extension. Can only be called once on a builder. After calling this method the current builder instance cannot be used any more.

Returns The Extension.

159.11.15.4 public FeatureExtensionBuilder setJSON(String json)

json The JSON to be added.

□ Add JSON in String form to the extension. Can only be called for extensions of type FeatureExtension.Type.JSON.

Returns This builder.

159.11.16 public interface FeatureService

The Feature service is the primary entry point for interacting with the feature model.

Concurrency Thread-safe

Provider Type Consumers of this API must not implement this type

159.11.16.1 public BuilderFactory getBuilderFactory()

□ Get a factory which can be used to build feature model entities.

Returns A builder factory.

159.11.16.2 public ID getID(String groupId, String artifactId, String version)

groupId The group ID (not null, not empty).

artifactId The artifact ID (not null, not empty).

version The version (not null, not empty).

□ Obtain an ID.

Returns The ID.

159.11.16.3 public ID getID(String groupId, String artifactId, String version, String type)

groupId The group ID (not null, not empty).

artifactId The artifact ID (not null, not empty).

version The version (not null, not empty).

type The type (not null, not empty).

□ Obtain an ID.

Returns The ID.

159.11.16.4 public ID getID(String groupId, String artifactId, String version, String type, String classifier)

groupId The group ID (not null, not empty).

artifactId The artifact ID (not null, not empty).

version The version (not null, not empty).

type The type (not null, not empty).

classifier The classifier (not null, not empty).

□ Obtain an ID.

Returns The ID.

159.11.16.5 public ID getIDfromMavenCoordinates(String coordinates)

coordinates The Maven Coordinates.

□ Obtain an ID from a Maven Coordinates formatted string. The supported syntax is as follows:

`groupId ':' artifactId ( ':' type ( ':' classifier )? )? ':' version`

Returns the ID.

159.11.16.6 public Feature readFeature(Reader jsonReader) throws IOException

jsonReader A Reader to the JSON input

□ Read a Feature from JSON

Returns The Feature represented by the JSON

Throws IOException– When reading fails

159.11.16.7 public void writeFeature(Feature feature, Writer jsonWriter) throws IOException

feature the Feature to write.

jsonWriter A Writer to which the Feature should be written.

□ Write a Feature Model to JSON

Throws IOException– When writing fails.

159.11.17 public interface ID

ID used to denote an artifact. This could be a feature model, a bundle which is part of the feature model or some other artifact.

Artifact IDs follow the Maven convention of having:

- A group ID
- An artifact ID
- A version
- A type identifier (optional)
- A classifier (optional)

Concurrency Thread-safe

Provider Type Consumers of this API must not implement this type

159.11.17.1 public static final String FEATURE_ID_TYPE = "osgifeature"

ID type for use with Features.

159.11.17.2 public String getArtifactId()

□ Get the artifact ID.

Returns The artifact ID.

159.11.17.3 public Optional<String> getClassifier()

□ Get the classifier.

Returns The classifier.

159.11.17.4 **public String getGroupId()**

□ Get the group ID.

Returns The group ID.

159.11.17.5 **public Optional<String> getType()**

□ Get the type identifier.

Returns The type identifier.

159.11.17.6 **public String getVersion()**

□ Get the version.

Returns The version.

159.11.17.7 **public String toString()**

□ This method returns the ID using the following syntax:

```
groupId ':' artifactId ( ':' type ( ':' classifier )? )? ':' version
```

Returns The string representation.

159.12 org.osgi.service.feature.annotation

Feature Annotations Package Version 1.0.

This package contains annotations that can be used to require the Feature Service implementation.

Bundles should not normally need to import this package as the annotations are only used at build-time.

159.12.1 Summary

- `RequireFeatureService` - This annotation can be used to require the Feature implementation.

159.12.2 @RequireFeatureService

This annotation can be used to require the Feature implementation. It can be used directly, or as a meta-annotation.

Retention CLASS

Target TYPE, PACKAGE

159.13 References

[1] *JSON (JavaScript Object Notation)*
https://www.json.org

[2] *JSMin (The JavaScript Minifier)*
https://www.crockford.com/javascript/jsmin.html

[3] *Apache Maven Pom Reference*
https://maven.apache.org/pom.html

160 Feature Launcher Service Specification

Version 1.0

160.1 Introduction

The *Feature Service Specification* on page 5 defines a model to design and declare Complex Applications and reusable Sub-Components that are composed of multiple bundles, configurations and other metadata. These models are, however, only descriptive and have no standard mechanism for installing them into an OSGi framework.

This specification focuses on turning these Features into a running system, by introducing the Feature Launcher and Feature Runtime. The Feature Launcher takes a Feature definition, obtains a framework instance for it and then starts the Feature in that environment. The Feature Runtime extends this capability to a running system, enabling one or more Features to be installed, updated, and later removed from a running OSGi framework.

The Launcher and Runtime also interact with the Configuration Admin Service, that is, they provide configuration to the system if it is present in the Feature being launched or installed.

160.1.1 Essentials

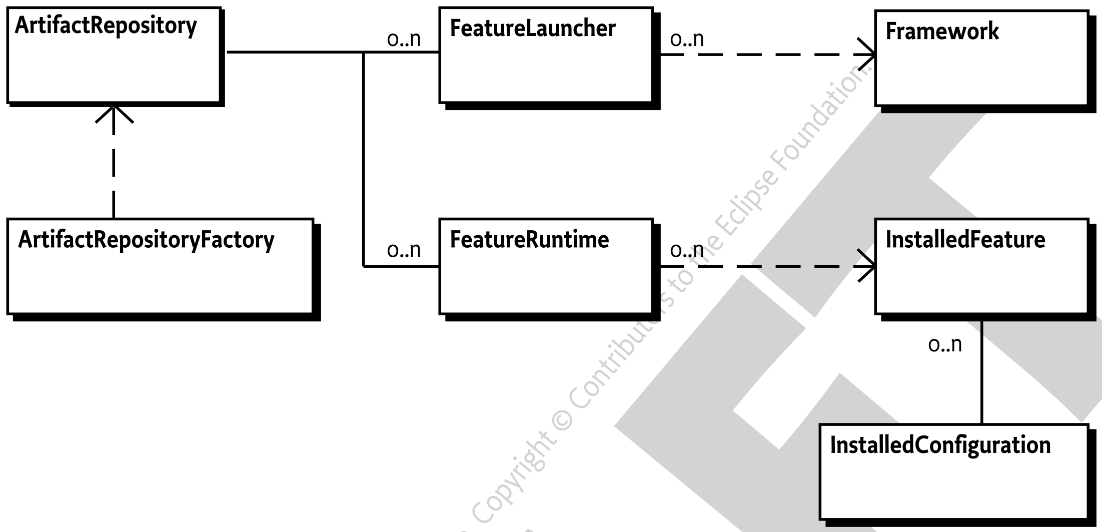
- *Dynamic* - The Feature Runtime dynamically adds, updates and removes Features in a running system.
- *Parameterizable* - Feature installation may be customised using local parameters if the Feature supports it.
- *Zero code* - The Feature Launcher can launch a framework containing an installed Feature in an implementation independent way without a user writing any code .

160.1.2 Entities

The following entities are used in this specification:

- *Feature* - A Feature as defined by the *Feature Service Specification* on page 5
- *Artifact Repository* - A means of accessing the installable bytes for bundles in a Feature
- *Feature Launcher* - A Feature Launcher obtains an OSGi Framework instance and installs a Feature into it.
- *Framework* - A running implementation of the OSGi core specification.
- *Launch Properties* - Framework launching properties defined in a Feature.
- *Feature Parameters* - Key value pairs that can be used to customise the installation of a Feature.
- *Configuration* - A configuration for the Configuration Admin service.
- *Feature Runtime* - A Feature Runtime is an OSGi service capable of installing Features into the running OSGi framework, removing installed Features from the OSGi framework, and updating an installed Feature with a new Feature definition.
- *Installed Feature* - A representation of a Feature installed by the Feature Runtime.
- *Installed Configuration* - A representation of a Configuration installed by the Feature Runtime.

Figure 160.1 *Features Entity overview*



160.2 Features and Artifact Repositories

OSGi Features exist either as JSON documents, or as runtime objects created by the Feature Service API. The primary purpose of a Feature is to define a list of bundles and configurations that should be installed, however the Feature provides no information about the location of the bundle artifacts. A key challenge with installing a Feature is therefore finding the appropriate artifacts to install.

The ArtifactRepository interface is designed to be implemented by users of the Feature Launcher Service to provide a way for the Feature Launcher Service to find an installable InputStream of bytes for a given bundle artifact using the getArtifact(ID) method. Artifact Repository implementations are free to use any mechanism for locating the bundle artifact data. If no artifact can be found for the supplied ID then the implementation of the Artifact Repository should return null. If the Artifact Repository throws an exception then this must be logged by the Feature Launcher Service and then treated in the same manner as a null return value.

160.2.1 The Artifact Repository Factory

In order to support the *Zero Code* objective of this specification, and to simplify usage for most users, the ArtifactRepositoryFactory provides a factory for commonly used repository types.

160.2.1.1 Obtaining an Artifact Repository Factory

The Artifact Repository Factory is useful both for the Feature Launcher and the Feature Runtime, and as such it must be easy to access both inside and outside an OSGi framework. The Feature Launcher Service implementation must provide an implementation of the Artifact Repository Factory interface. A user of the Artifact Repository Factory service may use the following ways to find an instance.

When outside OSGi:

- Using the Java ServiceLoader API to find instances of org.osgi.service.featurelauncher.ArtifactRepositoryFactory
- From configuration, and then using Class.forName, getConstructor() and newInstance()

- By hard coding the implementation and using the new operator.

When inside an OSGi framework:

- Using the OSGi service registry to find instances of org.osgi.service.featurelauncher.ArtifactRepositoryFactory
- Using the Java ServiceLoader API and the OSGi Service Loader Mediator to find instances of org.osgi.service.featurelauncher.ArtifactRepositoryFactory
- By hard coding the implementation type and using the new operator.

160.2.1.2 Local Repositories

A Local Repository is one that exists on a locally accessible file system. Note that this does not require that the file system is local, and technologies such as NFS or other network file systems would still be considered as Local Repositories. The key aspects of a Local Repository are that:

- The root of the repository can be accessed and resolved as a java.nio.file.Path or file: URI.
- The repository uses the Maven2 Repository Layout
Add bibliography link to https://maven.apache.org/repository/layout.html#maven2-repository-layout

An Artifact Repository representing a Local Repository can be created using the createRepository(Path) method, passing in the path to the root of the repository. A NullPointerException must be thrown if the path is null and an IllegalArgumentException must be thrown if the path does not exist, or represents a file which is not a directory.

An Artifact Repository representing a Local Repository can also be created using the createRepository(URI,Map) method, passing a URI using the file scheme which points to the root of the repository. A NullPointerException must be thrown if the URI is null and an IllegalArgumentException must be thrown if the path does not exist, or represents a file which is not a directory.

Once created this Artifact Repository will search the supplied repository for any requested artifact data. Implementations are free to optimise checks using repository metadata.

160.2.1.3 Remote Repositories

A Remote Repository is one that exists with an accessible http or https endpoint for retrieving artifact data. Note that this does not require that the repository is on a remote machine, only that the means of accessing data is via HTTP requests. The key aspects of a Remote Repository are that:

- The root of the repository can be accessed and resolved as a http or https URI
- The repository uses the Maven2 Repository Layout
Add bibliography link to https://maven.apache.org/repository/layout.html#maven2-repository-layout

An Artifact Repository representing a Remote Repository can be created using the createRepository(URI,Map) method, passing in the uri to the root of the repository. A NullPointerException must be thrown if the uri is null and an IllegalArgumentException must be thrown if the uri does not use the http or https scheme.

In addition to the repository URI the user may pass configuration properties in a Map. Implementations may support custom configuration properties, but those properties should use Reverse Domain Name keys. Keys not using the reverse DNS naming scheme are reserved for OSGi use. Implementations must ignore any configuration property keys that they do not recognise. All implementations must support the following properties:

- REMOTE_ARTIFACT_REPOSITORY_NAME - The name for this repository
- REMOTE_ARTIFACT_REPOSITORY_USER - The user name to use for authenticating with this repository

- REMOTE_ARTIFACT_REPOSITORY_PASSWORD - The password to use for authenticating with this repository
- REMOTE_ARTIFACT_REPOSITORY_BEARER_TOKEN - A bearer token to use when authenticating with this repository
- REMOTE_ARTIFACT_REPOSITORY_SNAPSHOTS_ENABLED - A Boolean indicating that SNAPSHOT versions are supported. Defaults to true
- REMOTE_ARTIFACT_REPOSITORY_RELEASES_ENABLED - A Boolean indicating that release versions are supported. Defaults to true
- REMOTE_ARTIFACT_REPOSITORY_TRUST_STORE - A trust store to use when validating a server certificate. May be a file system path or a data URI.
  ### Add bibliography link to https://en.wikipedia.org/wiki/Data_URI_scheme
- REMOTE_ARTIFACT_REPOSITORY_TRUST_STORE_FORMAT - The format of the trust store to use when validating a server certificate.
- REMOTE_ARTIFACT_REPOSITORY_TRUST_STORE_PASSWORD - The password to use when validating the trust store integrity.

Once created this Artifact Repository will search the supplied repository for any requested artifact data. Implementations are free to optimise checks using repository metadata.

160.3 Common themes

This specification includes support for bootstrapping an OSGi runtime, for ongoing management of an OSGi runtime, and for merging features. There are many concepts that apply across more than one of these scenarios, and so they are described here.

160.3.1 Overriding Feature variables

Some Feature definitions include variables which can be used to customise their deployment. These variables are intended to be set at the point where a Feature is installed, and may contain default values. To enable these variables to be overridden there are overloaded versions of methods which permit a Map of variables to be provided. The keys in this map must be strings and the values must be one of the types permitted by the *Feature Service Specification* on page 5

If a Feature declares a variable with no default value then this variable *must* be provided. If no value is provided then the method must fail to launch by throwing a LaunchException

160.3.2 Setting the bundle start levels

An OSGi framework contains a number of bundles which collaborate to produce a functioning application. There are times when some bundles require the system to have reached a certain state before they can be started. To address this use case the OSGi framework has the concept of *start levels.*
Add a link to the core specification

Setting the initial start level for the OSGi framework when bootstrapping can easily be achieved using the framework launch property org.osgi.framework.startlevel.beginning as defined by the OSGi core specification.

Controlling the start levels assigned to the bundles in a feature is managed through the use of Feature Bundle metadata. Specifically the Feature Launcher will look for a Feature Bundle metadata property named BUNDLE_START_LEVEL_METADATA which is of type integer and has a value between 1 and 2147483647 inclusive. If the property does not exist then the default start level will be used. If the property does exist and is not a suitable integer then launching must fail with a LaunchException.

Setting the default start level for the bundles, and the minimum start level required for an installed Feature is accomplished by using a Feature Extension named BUNDLE_START_LEVELS with Type

JSON. The JSON contained in this extension is used to configure the default start level for the bundles, and the target start level for the framework. The schema of this JSON is as follows: ### Add Schema in build

```
{
  "$schema": "https://json-schema.org/draft/2020-12/schema",
  "$id": "http://www.osgi.org/jsonschema/featurelauncher/bundle-start-levels/v1.0.0",
  "title": "bundle-start-levels",
  "description": "The definition of the bundle-start-levels feature extension",
   "type": "object",
   "properties": {
      "version": {
        "description": "The version of the Feature Launcher extension",
        "const": "1.0.0"
      },
      "defaultStartLevel": {
         "description": "The default start level for bundles in the feature",
         "type": "integer",
         "minimum": 1,
         "maximum": 2147483647
      },
      "minimumStartLevel": {
         "description": "The minimum required start level for the framework after feature in
         "type": "integer",
         "minimum": 1,
         "maximum": 2147483647
      }
   },
   "required": [ "version", "defaultStartLevel", "minimumStartLevel" ]
}
```

Setting the default start level for bundles installed by the framework is achieved using the defaultStartLevel property of the JSON extension. This must be an integer greater than zero and less than Integer.MAX_INT, or the special marker value null. A null value is used to indicate that the default start level for newly installed bundles is the current framework start level, or 1 if the current framework start level is 0. If the value is not valid then a LaunchException must be thrown when attempting to use the feature.

The minimum final start level for the OSGi framework required by the feature can be set using the minimumStartLevel property. of the JSON extension. This must be an integer greater than zero and less than Integer.MAX_INT. If the value is not valid then a LaunchException must be thrown when attempting to use the feature. This property sets the minimum start level that the OSGi framework must use to complete the installation of a Feature.

Finally the version property defines the version of the extension schema being used. This can be used by the implementation to determine whether the Feature is targeting a newer version of the specification. If the version is not understood by the implementation then a LaunchException must be thrown when attempting to use the feature.

160.4 The Feature Launcher

The FeatureLauncher is the main entry point for creating a running OSGi framework containing the bundles and configurations defined in a Feature. As such the Feature Launcher is primarily designed for use outside of an OSGi framework.

To support usage in a non-OSGi environment implementations of the Feature Launcher Service must register the following implementation classes with the Java ServiceLoader API, and any necessary module metadata.

- org.osgi.service.featurelauncher.FeatureLauncher
- org.osgi.service.featurelauncher.ArtifactRepositoryFactory

160.4.1 Obtaining and configuring a Feature Launcher

A Feature Launcher Service implementation must provide an implementation of the Feature Launcher interface. A user of the Feature Launcher service may use the following ways to find this class and create an instance:

- Using the Java ServiceLoader API to find instances of org.osgi.service.featurelauncher.FeatureLauncher
- From configuration, and then using Class.forName, getConstructor() and newInstance()
- By hard coding the implementation type and using the new operator.

Once instantiated the Feature Launcher may be configured in a fluent manner using the configure(Map) and addRepository(ArtifactRepository) methods. Configuration properties for the Feature Launcher are implementation specific, and any unrecognised property names should be ignored. Artifact Repository instances may be created by the user using as described in *The Artifact Repository Factory on page 28*, or using custom implementations.

160.4.1.1 Thread Safety

Instances of the Feature Launcher are not required to be Thread Safe, and should not be shared between threads. Changing the configuration of a Feature Launcher instance only affects that instance, and not any other instances that exist.

160.4.2 Using a Feature Launcher

Once a configured Feature Launcher instance has been created, one of the launch methods can be used to launch an OSGi framework containing the supplied Feature. Features can either be supplied as a Reader providing access to the JSON text of a Feature document or a parsed Feature. The Feature Launcher will then return a running Framework instance representing the launched OSGi framework and the Feature that it contains. If an error occurs creating the framework, or locating and installing any of the feature bundles, then a LaunchException must be thrown.

Once the caller has received their framework instance they may carry on with other work, or they may wait for the OSGi framework to stop using the waitForStop() method.

160.4.2.1 Providing Framework Launch Properties

Framework launch properties are key value pairs which are passed to the OSGi framework as it is created. They can control many behaviours, including operations which happen before the framework starts, meaning that is not always possible to set them *after* startup.

Feature definitions that require particular framework launch properties can define them using a Feature Extension named FRAMEWORK_LAUNCHING_PROPERTIES. The Type of this Feature Extension must be TEXT, where each entry is in the form key=value All implementations of the Feature Launcher must support this extension, and use it to populate the Framework Launch Properties.

In addition to Framework Launch properties defined inside the Feature, users of the Feature Launcher can add and override Framework Launch Properties using one of the launch methods which permit a Map of framework properties to be provided. Any key value pairs defined in this map must take precedence over those defined in the Feature. A key with a null value must result in the removal of a key value pair if it is defined in the Feature.

160.4.2.2 Selecting a framework implementation

When defining a feature it is not always possible to be framework independent. Sometimes specific framework APIs, or licensing restrictions, will require that a particular implementation is used. In this case a Feature Extension named LAUNCH_FRAMEWORK with Type ARTIFACTS can be used to list one or more artifacts representing OSGi framework implementations.

The list of artifacts is treated as a preference order, with the first listed artifact being used if available, and so on, until a framework is found. If a listed artifact is not an OSGi framework implementation then the Feature Launcher must log a warning and continue on to the next artifact in the list. If the Kind of the feature is MANDATORY and none of the listed artifacts are available then launching must fail with a LaunchException.

The Feature Launcher implementation may identify that an artifact is an OSGi framework implementation in any way that it chooses, however it must recognise framework implementations that provide the Framework Launch API using the service loader pattern. ### Link to the framework launch API

160.4.2.3 A simple example

The following code snippet demonstrates a simple example of using the Feature Launcher to start an OSGi framework containing one or more bundles.

```
// Load the Feature Launcher
ServiceLoader<FeatureLauncher> sl = ServiceLoader.load(FeatureLauncher.class);
FeatureLauncher launcher = sl.iterator().next();

// Set up a repository
ArtifactRepository localRepo = launcher.createRepository(Paths.get("bundles"));
launcher.addRepository(localRepo);

// Launch the framework
Framework fw = launcher.launch(Files.newBufferedReader(Paths.get("myfeature.json")));
fw.waitForStop(0);
```

160.4.3 The Feature Launching Process

The following section defines the process through which the Feature Launcher must locate, initialize and populate an OSGi framework when launching a feature. Unless explicitly stated implementations may perform one or more parts of this process in a different order to that described in the specification.

160.4.3.1 Locating a framework implementation

Before a framework instance can be created the Feature Launcher must identify a suitable implementation using the following search order:

1. If any provider specific configuration has been given to the Feature Launcher implementation then this should be used to identify the framework.
2. If the Feature declares an Extension LAUNCH_FRAMEWORK then the Feature Launcher implementation must use the first listed artifact that can be found in any configured Artifact Repositories, as described in *Selecting a framework implementation* on page 33.

Currently this only fails if the extension is mandatory

3. If no framework implementation is found in the previous steps then the Feature Launcher implementation must search the classpath using the Thread Context Class Loader, or, if the Thread Context Class Loader is not set, the Class Loader which loaded the caller of the Feature Launcher's launch method. The first suitable framework instance located is the instance that will be used.
4. In the event that no suitable OSGi framework can be found by any of the previous steps then the Feature Launcher implementation may provide a default framework implementation to be used.

If no suitable OSGi framework implementation can be found then the Feature Launcher implementation must throw a LaunchException.

160.4.3.2 Creating a Framework instance

Once a suitable framework implementation has been located the Feature Launcher implementation must create and initialize a framework instance. Implementations are free to use implementation specific mechanisms for framework implementations that they recognise. The result of this initialization must be the same as if the Feature Launcher used the org.osgi.framework.launch.FrameworkFactory registered by the framework implementation to create the framework instance.

When creating the framework any framework launch properties defined in the Feature must be used. These are defined as described in *Providing Framework Launch Properties* on page 32 and must include any necessary variable replacement as defined by *Overriding Feature variables* on page 30.

Once instantiated the framework must be initialised appropriately so that it has a valid BundleContext. Once initialised the framework is ready for the Feature Launcher implementation to begin populating the framework.

160.4.3.3 Installing bundles and configurations

The Feature Launcher must iterate through the list of bundles in the feature, installing them in the same order that they are declared in the feature. If bundle start levels have been defined, as described in *Setting the bundle start levels* on page 30, then the Feature Launcher must ensure that the start level is correctly set for each installed bundle. If no start level metadata or extension is defined then all bundles are installed with the framework default start level.

If a Feature defines one or more Feature Configurations then these cannot be guaranteed to be made available until the ??? service has been registered. A Feature Launcher implementation may provide an implementation specific way to pre-register configurations, however in general the Feature Launcher should listen for the registration of the ConfigurationAdmin service and immediately create the defined configurations when it becomes available. Configurations must be created in the same order as they are defined in the Feature.

If the CONFIGURATION_TIMEOUT configuration property is set to 0, and one or more Feature Configurations are defined in the Feature being installed, then the implementation must throw a LaunchException unless it is capable of pre-registering those configurations in an implementation specific way.

160.4.3.4 Starting the framework

Once all of the the bundles listed in the feature are installed, and any necessary configuration listener is registered, the implementation must start the OSGi framework. This action will automatically start the installed bundles as defined by the initial start level of the framework, and the start levels of the installed bundles.

The Feature Launcher implementation must delay returning control to the caller until all configurations have been created, subject to the timeout defined by CONFIGURATION_TIMEOUT. The default timeout is 5000 milliseconds, and it determines the maximum length of time that the Feature Launcher implementation should wait to begin creating the configurations. A value of -1 indicates that the Feature Launcher implementation must not wait, and must continue immediately, even if the configurations have not yet been created. If it is not possible to begin before the timeout expires then a LaunchException must be thrown.

Finally, if the minimumStartLevel has been set by the BUNDLE_START_LEVELS extension then the Feature Launcher implementation must check the current start level of the framework. If the current start level is less than the value of minimumStartLevel then the framework's start level must be set to this value.

Once the start process is complete the Framework instance must be returned to the caller.

The following failure modes must all result in a LaunchException being thrown:

- A bundle fails to resolve. If one of the installed bundles fails to resolve this is an error *unless* the Feature is not complete. For Features that are not complete resolution failures must be logged, but not cause a failure.
- A resolved bundle fails to start. If one of the resolved bundles fails to start this is an error *unless* the bundle is a fragment or an extension bundle, which the Feature Launcher should not attempt to start.
- A configuration cannot be created. If a configuration cannot be created then this must result in a start failure

If a launching failure is triggered by an exception, for example a ??? then this must be set as the cause of the LaunchException that is thrown.

160.4.3.5 Cleanup after failure

If the Feature Launcher implementation fails to launch a feature then any intermediate objects must be properly closed and discarded. For example if an OSGi framework instance has been created then it must be stopped and discarded.

160.5 The Feature Runtime Service

The Feature Runtime Service can be thought of as an equivalent of the Feature Launcher for an existing, running OSGi framework. The Feature Runtime Service therefore does not offer any mechanism for launching a framework, but instead allows one or more features to be installed into the running framework. As an OSGi framework is a dynamic environment the Feature Runtime Service also provides DTOs describing the currently installed Features, allows installed Features to be updated, and allows Features to be removed from the system.

An important difference between the Feature Launcher and Feature Runtime Service is that because the Feature Runtime Service allows multiple Features to be installed it must be able to identify and resolve simple conflicts. For example if two Features include the same bundle at different versions then the resolution may be to install only the higher version, or both versions.

160.5.1 Using the Feature Runtime

The Feature Runtime must be registered as a service in the service registry. Management agents that wish to install, manage or introspect Features in the framework must obtain this service. The Feature Service Runtime service must advertise both the ??? and ArtifactRepositoryFactory interfaces, and be registered with prototype scope.

160.5.1.1 Thread Safety

Instances of the Feature Runtime are not required to be Thread Safe, and should not be shared between threads. Changing the configuration, for example the configured Artifact Repositories, of a Feature Runtime instance only affects that instance, and not any other instances that exist.

Despite the instances not being Thread Safe the underlying Feature Runtime must be Thread Safe, specifically if two instances of the Feature Runtime are used at the same time then these calls should be handled sequentially such that there are never partially deployed Features present when installing, updating or removing a Feature.

160.5.1.2 Introspecting the installed Features

An important role for any management agent is being able to introspect the system to discover its current state. The Feature Runtime enables this through the ??? method, which returns a DTO snapshot of the current state of the system.

The returned list of DTOs contains one ??? entry for each installed Feature, in the order that they were installed, and may be empty if no Features have been installed. If the framework was started using a Feature Launcher from the same implementation as the Feature Runtime then the Feature Runtime may choose to represent the launched Feature in the DTO list. If the launched Feature is included in the DTO list then it must set ??? to `true`. Launch features cannot be removed or updated by the Feature Runtime, and any attempt to do so must throw a `LaunchException`

Each Installed Feature DTO includes the id of the Feature, and a `Map` referencing the bundles installed by the feature. The keys of the map are the installed bundles, and the values each contain a `List` of the ids of the features which *own* the bundle. Ownership of a bundle is tracked by the Feature Runtime, and it is used to identify when the same bundle forms part of more than one Feature. Bundles that are owned by more than one Feature will not be removed until *all* of the Features that own them are removed. In the case where a bundle was not installed by the Feature Runtime, but later became owned by an installed Feature, that bundle will also be owned by the virtual `org.osgi:external:1.0.0` Feature to indicate that they will not be removed if the other owning Feature is removed. ### Make a constant for this

In addition to bundles Features can contain configurations. The InstalledFeatureDTO therefore contains a `List` of ??? DTOs, with each entry representing a configuration created by the Feature Runtime on behalf of the Feature. The Installed Configuration DTO contains the following information:

- ??? - The id of the Feature for which this Installed Configuration was created.
- ??? - The configuration pid of this configuration.
- ??? - The factory pid of this configuration, or `null` if the configuration is not a factory configuration.
- ??? - The merged configuration properties that result from the full set of installed Features contributing to this configuration. Note that there is no dynamic link to Configuration Admin and so any configuration changes made outside the Feature Runtime will not be reflected.

160.5.1.3 Setting the available Artifact Repositories

As with the Feature Launcher, in order to successfully locate the bundles listed in a feature the Feature Runtime must have access to one or more Artifact Repositories capable of locating the bundles. A configured Feature Runtime freshly obtained from the service registry will typically include one or more pre-defined Artifact Repositories. These pre-defined repositories will remain available through the ??? regardless of any changes made to the Artifact Repositories available to the Feature Runtime instance held by the user.

Additional Artifact Repositories can be added by calling the ??? method. The supplied `name` is used to identify the repository, and will be used as the key when returning the `Map` of configured repositories from ???. If the supplied name is already used for an existing Artifact Repository then it will be replaced.

Artifact Repositories can be removed using the ??? method. This can be useful in the case that the caller wants to completely clear the default Artifact Repositories and only use their directly configured instances. The default Artifact Repositories can be reset either by discarding the Feature Runtime instance and obtaining a new prototype scoped instance, or by clearing the existing Artifact Repositories and re-adding the defaults from `getDefaultRepositories`.

160.5.1.4 Installing a feature

Installing a Feature uses one of the `install` methods present on the Feature Runtime. These methods allow the caller to provide the Feature to be installed, and also a `Map` of variable overrides as described in *Overriding Feature variables* on page 30. The end result of installing a Feature is that all of the bundles listed in the Feature are installed, all of the Feature Configurations have been created, all bundles have been marked as persistently started, and the framework start level is at least the minimum level required by the Feature.

Start levels for the bundles in the Feature may be controlled as described in *Setting the bundle start levels* on page 30. If any bundles are installed with a start level higher than the current framework start level then they will be marked persistently started but will not start until the framework start level is changed.

In more complex cases, where multiple features are installed with overlapping bundles or configurations then *Merging strategies* on page 39 will be applied to determine which bundles are installed, and what configuration properties will be used when creating or updating a configuration.

Action on failure

160.5.1.5 Removing a Feature

Bundles

Configurations

refreshing packages

Action on failure

160.5.1.6 Updating a Feature

Bundles

Configurations

refreshing packages

Action on failure

160.5.2 The Feature Runtime Behaviour

The following section provides normative requirements for the behaviour of the Feature Runtime when it is used. This includes the necessary end states after installation, update and removal of Features.

160.5.2.1 The Feature installation process

The Feature Installation process has three main phases:

- The the bundle installation phase, where Feature bundles are installed
- The the configuration creation phase, where Feature Configurations are created
- The the Feature Start phase, where Bundles are started.

The the bundle installation phase and the configuration creation phase may happen in any order, or even with interleaved steps, however the Feature Start phase must not begin until the bundle installation and configuration creation phases are complete.

160.5.2.1.1 Bundle Installation

When a feature is being installed the Feature Runtime identifies the bundles to be installed. The Feature Runtime also gathers the set of bundles that are already installed, and then computes the overlap between these. Bundles are deemed to overlap if they have the same group id, artifact id, type and classifier but they may differ in version.

If the overlap list contains entries which overlap exactly, that is they have the same version in the runtime and the Feature being installed, then those bundles are removed from the list of bundles to be installed and the existing bundles are marked as *owned* by the Feature being installed. If the marked bundles were not previously owned by any other feature then they also marked as owned by the osgi.external Feature to indicate that they will not be removed if the Feature being installed is removed. ### Make a constant for this

Any remaining overlap entries are processed according to the merge strategy for the feature, as described in *Merging Bundles* on page 39. The final list of bundles to install, which excludes any already installed bundles, is then installed in the same order as it was defined by the feature. Each bundle in the feature, including bundles that were already installed, is then marked as owned by the installing feature.

160.5.2.1.2 Configuration Creation

As part of the initial Feature installation the Feature Runtime must also process and create any Feature Configurations that are defined in the Feature. Feature Configurations cannot be guaranteed to be made available until a ??? service has been registered. A Feature Runtime implementation should therefore listen for the registration of a ConfigurationAdmin service and immediately create or update any pending configurations when it becomes available. Configurations must be created or updated in the same order as they are defined in the Feature.

If the same configuration, as identified by its configuration pid, is defined in one or more existing installed Features then the configuration properties to be used are determined by merging the previous configuration properties with the new properties defined in the Feature, as described in *Merging Configurations* on page 39. If at the point where the FeatureRuntime attempts to create or update a Feature Configuration there are already configuration properties defined in ConfigurationAdmin then these must be ignored and replaced using ??? unless the Configuration is marked as ???. If a READ_ONLY configuration does exist then the Feature Runtime must log a warning and skip that configuration.

160.5.2.1.3 Feature Start

Once all of the bundles listed by the feature are installed then the bundles' start levels are assigned as described in *Setting the bundle start levels* on page 30. This includes any pre-existing bundles and the results of any merge operations. If no start level configuration is defined in the feature for a particular bundle then the start level for that bundle is set to the current start level of the framework.

The Feature Runtime must then identify the lowest start level referenced in the Feature, and repeatedly run through the list of bundles, in the order that they are defined in the Feature, looking for bundles which match the identified start level. For each bundle the Feature Runtime must:

- If the bundle was installed in the Bundle Installation phase then set the start level for the bundle.
- If the bundle was already installed then update the start level for the bundle if, and only if, the new start level is lower than the existing start level.
- Mark the bundle as persistently started unless it is a *fragment* bundle.

The Feature Runtime must then identify the next lowest start level referenced in the Feature and repeat this process until all bundles have been persistently started. Once this process is complete then the framework start level must be increased to the minimum start level required by the Feature.

160.5.2.1.4 Failure scenarios

TODO

Missing bundles

Merge failure

Missing variables

Start failures

160.5.3 Merging strategies

TODO

160.5.3.1 Merging Bundles

Bundles

160.5.3.2 Merging Configurations

Configurations

160.6 org.osgi.service.featurelauncher

Feature Launcher Package Version 1.0.

Bundles wishing to use this package must list the package in the Import-Package header of the bundle's manifest. This package has two types of users: the consumers that use the API in this package and the providers that implement the API in this package.

Example import for consumers using the API in this package:

`Import-Package: org.osgi.service.feature; version="[1.0,2.0)"`

Example import for providers implementing the API in this package:

`Import-Package: org.osgi.service.feature; version="[1.0,1.1)"`

160.6.1 Summary

- `ArtifactRepository` - An ArtifactRepository is used to get hold of the bytes used to install an artifact.
- `ArtifactRepositoryFactory` - A ArtifactRepositoryFactory is used to create implementations of ArtifactRepository for one of the built in repository types:
  - Local File System
  - HTTP repository
- `FeatureLauncher` - The Feature launcher is the primary entry point for launching an OSGi framework and set of bundles.
- `FeatureLauncherConstants` - Defines standard constants for the Feature Launcher specification.
- `LaunchException` - A LaunchException is thrown by the FeatureLauncher if it is unable to:
  - Locate or start an OSGi Framework instance
  - Locate the installable bytes of any bundle in a Feature
  - Install a bundle in the Feature
  - Determine a value for a Feature variable that has no default value defined

160.6.2 public interface ArtifactRepository

An ArtifactRepository is used to get hold of the bytes used to install an artifact. Users of this specification may provide their own implementations for use when installing feature artifacts. Instances must be Thread Safe.

Concurrency Thread-safe

160.6.2.1 public InputStream getArtifact(ID id)

id the id of the artifact

□ Get a stream to the bytes of an artifact

Returns an InputStream containing the bytes of the artifact or null if this repository does not have access to the bytes

160.6.3 public interface ArtifactRepositoryFactory

A ArtifactRepositoryFactory is used to create implementations of ArtifactRepository for one of the built in repository types:

- Local File System
- HTTP repository

Provider Type Consumers of this API must not implement this type

160.6.3.1 public ArtifactRepository createRepository(Path path)

path a path to the root of a Maven Repository Layout containing installable artifacts

□ Create an ArtifactRepository using the local file system

Returns an ArtifactRepository using the local file system

Throws IllegalArgumentException– if the path does not exist, or exists and is not a directory

NullPointerException– if the path is null

160.6.3.2 public ArtifactRepository createRepository(URI uri, Map<String, Object> props)

uri the URI for the repository. The http, https and file schemes must be supported by all implementations.

props the configuration properties for the remote repository. See FeatureLauncherConstants for standard property names

□ Create an ArtifactRepository using a remote Maven repository.

Returns an ArtifactRepository using the local file system

Throws IllegalArgumentException– if the uri scheme is not supported by this implementation

NullPointerException– if the path is null

160.6.4 public interface FeatureLauncher extends ArtifactRepositoryFactory

The Feature launcher is the primary entry point for launching an OSGi framework and set of bundles. As it is a means for launching a framework it is designed to be used from outside OSGi and therefore should be obtained using the ServiceLoader.

Provider Type Consumers of this API must not implement this type

160.6.4.1 public FeatureLauncher addRepository(ArtifactRepository repository)

repository the repository to add

□ Add a repository to this FeatureLauncher that will be used to locate installable artifact data.

Returns this

160.6.4.2 public FeatureLauncher configure(Map<String, Object> configuration)

configuration the repository to add

□ Configure this FeatureLauncher with the supplied properties.

Returns this

160.6.4.3 public Framework launch(Feature feature)

feature the feature to launch

□ Launch a framework instance based on the supplied feature

Returns A running framework instance.

Throws LaunchException–

160.6.4.4 public Framework launch(Reader jsonReader)

jsonReader a Reader for the input Feature JSON

□ Launch a framework instance based on the supplied feature JSON

Returns A running framework instance.

Throws LaunchException–

160.6.4.5 public Framework launch(Feature feature, Map<String, Object> variables)

feature the feature to launch

variables key/value pairs to set variables in the feature

□ Launch a framework instance based on the supplied feature and variables

Returns A running framework instance.

Throws LaunchException–

IllegalArgumentException– if any of the variable values is not one of the values defined for Feature.getVariables():

- java.lang.String
- java.lang.Boolean
- java.math.BigDecimal

160.6.4.6 public Framework launch(Reader jsonReader, Map<String, Object> variables)

jsonReader a Reader for the input Feature JSON

variables key/value pairs to set variables in the feature

□ Launch a framework instance based on the supplied feature JSON and variables

Returns A running framework instance.

Throws LaunchException– if an error occurs in launching

IllegalArgumentException– if any of the variable values is not one of the values defined for Feature.getVariables():

- java.lang.String
- java.lang.Boolean
- java.math.BigDecimal

160.6.4.7 public Framework launch(Feature feature, Map<String, Object> variables, Map<String, String> frameworkProperties)

feature	the feature to launch
variables	key/value pairs to set variables in the feature
frameworkProperties	set or override framework properties when launching the framework

□ Launch a framework instance based on the supplied feature, variables and framework properties

Returns A running framework instance.

Throws LaunchException–

IllegalArgumentException– if any of the variable values is not one of the values defined for Feature.getVariables():

- java.lang.String
- java.lang.Boolean
- java.math.BigDecimal

160.6.4.8 public Framework launch(Reader jsonReader, Map<String, Object> variables, Map<String, String> frameworkProperties)

jsonReader	a Reader for the input Feature JSON
variables	key/value pairs to set variables in the feature
frameworkProperties	set or override framework properties when launching the framework

□ Launch a framework instance based on the supplied feature JSON

Returns A running framework instance.

Throws LaunchException–

IllegalArgumentException– if any of the variable values is not one of the values defined for Feature.getVariables():

- java.lang.String
- java.lang.Boolean
- java.math.BigDecimal

160.6.5 public final class FeatureLauncherConstants

Defines standard constants for the Feature Launcher specification.

160.6.5.1 public static final String BUNDLE_START_LEVEL_METADATA = "bundleStartLevel"

The name of the metadata property used to indicate the start level of the bundle to be installed. The value must be an integer between 0 and Integer.MAX_VALUE.

160.6.5.2 public static final String BUNDLE_START_LEVELS = "bundle-start-levels"

The name for the FeatureExtension of Type.JSON which defines the start level configuration for the bundles in the feature

160.6.5.3 public static final String CONFIGURATION_TIMEOUT = "configuration.timeout"

The configuration property used to set the timeout for creating configurations from FeatureConfiguration definitions.

The value must be a Long indicating the number of milliseconds that the implementation should wait to be able to create configurations for the Feature. The default is 5000.

A value of 0 means that the configurations must be created before the bundles in the feature are started. In general this will require the ConfigurationAdmin service to be available from outside the feature.

A value of -1 means that the implementation must not wait to create configurations and should return control to the user as soon as the bundles are started, even if the configurations have not yet been created.

160.6.5.4 public static final String FEATURE_LAUNCHER_IMPLEMENTATION = "osgi.featurelauncher"

The name of the implementation capability for the Feature specification.

160.6.5.5 public static final String FEATURE_LAUNCHER_SPECIFICATION_VERSION = "1.0"

The version of the implementation capability for the Feature specification.

160.6.5.6 public static final String FRAMEWORK_LAUNCHING_PROPERTIES = "framework-launching-properties"

The name for the FeatureExtension of Type.TEXT which defines the framework properties that should be used when launching the feature.

160.6.5.7 public static final String LAUNCH_FRAMEWORK = "launch-framework"

The name for the FeatureExtension which defines the framework that should be used to launch the feature. The extension must be of Type.ARTIFACTS and contain one or more ID entries corresponding to OSGi framework implementations. This extension must be processed even if it is Kind.OPTIONAL or Kind.TRANSIENT.

If more than one framework entry is provided then the list will be used as a priority order when determining the framework implementation to use. If none of the frameworks are present then an error is raised and launching will be aborted.

160.6.5.8 public static final String REMOTE_ARTIFACT_REPOSITORY_BEARER_TOKEN = "token"

The configuration property key used to set the bearer token when creating an ArtifactRepository using FeatureLauncher.createRepository(URI, Map)

160.6.5.9 public static final String REMOTE_ARTIFACT_REPOSITORY_NAME = "name"

The configuration property key used to set the repository name when creating an ArtifactRepository using FeatureLauncher.createRepository(URI, Map)

160.6.5.10 public static final String REMOTE_ARTIFACT_REPOSITORY_PASSWORD = "password"

The configuration property key used to set the repository password when creating an ArtifactRepository using FeatureLauncher.createRepository(URI, Map)

160.6.5.11 public static final String REMOTE_ARTIFACT_REPOSITORY_RELEASES_ENABLED = "release"

The configuration property key used to set that release versions are enabled for an ArtifactRepository using FeatureLauncher.createRepository(URI, Map)

160.6.5.12 public static final String REMOTE_ARTIFACT_REPOSITORY_SNAPSHOTS_ENABLED = "snapshot"

The configuration property key used to set that SNAPSHOT release versions are enabled for an ArtifactRepository using FeatureLauncher.createRepository(URI, Map)

160.6.5.13 public static final String REMOTE_ARTIFACT_REPOSITORY_TRUST_STORE = "truststore"

The configuration property key used to set the trust store to be used when accessing a remote ArtifactRepository using FeatureLauncher.createRepository(URI, Map)

160.6.5.14 public static final String REMOTE_ARTIFACT_REPOSITORY_TRUST_STORE_FORMAT = "truststoreFormat"

The configuration property key used to set the trust store format to be used when accessing a remote ArtifactRepository using FeatureLauncher.createRepository(URI, Map)

160.6.5.15 public static final String REMOTE_ARTIFACT_REPOSITORY_TRUST_STORE_PASSWORD = "truststorePassword"

The configuration property key used to set the trust store password to be used when accessing a remote ArtifactRepository using FeatureLauncher.createRepository(URI, Map)

160.6.5.16 public static final String REMOTE_ARTIFACT_REPOSITORY_USER = "user"

The configuration property key used to set the repository user when creating an ArtifactRepository using FeatureLauncher.createRepository(URI, Map)

160.6.6 public class LaunchException extends RuntimeException

A LaunchException is thrown by the FeatureLauncher if it is unable to:

- Locate or start an OSGi Framework instance
- Locate the installable bytes of any bundle in a Feature
- Install a bundle in the Feature
- Determine a value for a Feature variable that has no default value defined

160.6.6.1 public LaunchException(String message)

message

□ Create a LaunchException with the supplied error message

160.6.6.2 public LaunchException(String message, Throwable cause)

message

cause

□ Create a LaunchException with the supplied error message and cause

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