RFC-218 Configurator

Draft

22 Pages

Abstract

10 point Arial Centered.

OSGi Configuration Admin is a slightly pedantic but highly effective flexible standardized model to configure applications. This RFC seeks a solution to carry configuration information in a bundle.

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0.3 Feedback

This document can be downloaded from the OSGi Alliance design repository at https://github.com/osgi/design The public can provide feedback about this document by opening a bug at https://www.osgi.org/bugzilla/.

0.4 Table of Contents

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0.5 Terminology and Document Conventions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY" and "OPTIONAL" in this document are to be interpreted as described in 10.1.

`Source code is shown in this typeface.`

0.6 Revision History

The last named individual in this history is currently responsible for this document.

Revision	Date	Comments
Initial	*DEC 04 2015*	*Initial Version* *Carsten Ziegeler, Adobe <cziegele@adobe.com>*

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Revision	Date	Comments
Update	*DEC 17 2015*	*Updated based on EEG call* *Rewrote most parts* *Carsten Ziegeler, Adobe <cziegele@adobe.com>*
0.2	January, 2016	David Bosschaert, updates from F2F meeting in Madrid
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0.6	MAY-20-2016	Move Configuration Admin Service Updates to RFC 227 Update binary handling Carsten Ziegeler, Adobe <cziegele@adobe.com>
07	JUN-28-2016	Update binary handling, F2F Darmstadt Carsten Ziegeler, Adobe
08	DEC-15-2016	Move from YAML to JSON Carsten Ziegeler, Adobe
09	JAN-13-2017	Feedback from spec chapter writing Carsten Ziegeler, Adobe

1 Introduction

This RFC originates from the OSGi enRoute work. In this project, a number of services were identified, designed and implemented based on their needs for web based applications. This document analyzes the application domain and defines the problem that needs to be solved.

This RFC discusses the Configurator, an extender that allows the storage of configuration data in a bundle.

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2 Application Domain

OSGi provides a standardized model to provide bundles with configurations. This is specified in the Configuration Admin specification. In this specification, A configuration is identified by a persistent identity (PID). A PID is a unique token, recommended to be conforming to the symbolic name syntax. A configuration consists of a set of properties, where a property consists of a string key and a corresponding value. The type of the value is limited to the primitive types and their wrappers, Strings, or Java Arrays/List/Vector of these.

Sometimes it is necessary to store binary large objects (BLOB) in configuration. For example, a keystore with certificates. Since configuration admin is not suitable for this, these BLOBs are often stored on the files system. The application developers then must manage the life cycles of these files.

Configurations can be grouped with a factory PID. Configurations with a factory PID are called *factory* configurations and without it they are called *singleton* configurations.

The original specification specified that the configurations were sent to a Managed Service for the singletons and Managed Service Factory services for the factory instances. However, over time *component models* became popular and a component can rely on configuration. For example, Declarative Services is tightly integrated with Configuration Admin. For these heavy users of configurations a *Configuration Listener* whiteboard service was added. Configuration update, delete, and bundle location change events are forwarded to this whiteboard service on a background thread.

2.1 Coordination

In OSGi, the *management agent* creates and deletes configurations through the Configuration Admin service. Appropriate Create/Read/Update/Delete (CRUD) methods for singletons and factories are available on this service. If the management agent performs a number of sequential updates then it can group these updates within a Coordination from the Coordinator service. Clients can then register a Synchronous Configuration Listener and delay the application of the properties until the Coordination has ended.

2.2 Logical PIDs

One popular management agent from the early days was *File Install [3].*. File install watched a directory and configurations stored in that directory were configured in the local Configuration Admin. This is straightforward for singletons since the file name of the configuration file can be used to calculate the PID. However, for factories, the PID for the instance is calculated by Configuration Admin and is not predictable. Therefore, File Install needed to manage the number of instances since the operations to create them were not idempotent. To prevent a restart from creating an every growing number of instances it was necessary to create a link between the instance and the file. Therefore, File Install created a *logical (instance) PID* based on the file name. If this instance was detected, File Install first looks in Configuration Admin if there is any instance that has this logical PID as value in a specially designated key. Only if no such instance was found, a new one was created. This made the operation idempotent.

2.3 Delivery

The Deployment Admin specification developed for OSGi Mobile provided the means to carry configuration information inside a JAR via the means of *resource processors*. The Auto Configuration specification defined how an Autoconf resource processor could get an XML file from a Deployment Package. Since the Deployment

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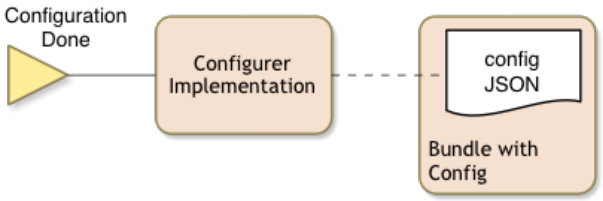
Package could not define the instance PID for a factory it used an alias in the XML file. When a configuration was found, the alias was looked up to see to what instance PID it was mapped to. If no mapping was found, a new instance was created. Since Deployment Packages had a well defined life cycle, they basically are like bundles, Deployment Admin could therefore also delete stale aliases.

2.4 OSGi Application Model

The Require-Capability model was designed to create applications from one or more *initial requirements*, generally identity requirements, to so called *root bundles*. From these initial requirements a *resolver*, generally with some human help, can then create a *deployable artifact*. For example an executable JAR which includes all dependencies including configuration, a subsystem specification, an Eclipse or subsystem features, etc.

2.5 OSGi enRoute Configurer

The enRoute project defined a *Configurer extender [4].*. Bundles can store configuration data in a “magic” resource at `configuration/configuration.json`. This is a JSON file containing an array of configurations. When a bundle is installed, the Configurer detects the magic resource and installs the corresponding configuration. It does not remove the configuration when the bundle is uninstalled. The Configurer uses logical PIDs to manage factories.



Before the JSON file is interpreted, the Configurer will first run it through a macro pre-processor, this is the bndlib [5]. macro preprocessor. The macro sequence is `@{...}` to not clash with build time processing.

The Configurer also supports BLOBs. A special macro `@{resource:<resource>}` points to a resource in the bundle. The Configurer will then extract this resource to the file system and replace the macro with the actual file path. The Configurer stores this data by default in the bundle's file area.

Additionally, the Configurer also read a standard system property and interpreted the content as a JSON configuration file.

3 Problem Description

The trend in OSGi is to use the Require-Capability model to construct applications out of a set of initial requirements. This means there is no applicable container like Deployment Admin to contain configurations. However, enRout shows that it is actually quite easy to store configuration data in a bundle which can then be part of the resolve process. This configuration bundle can be a root bundle representing the application or a special

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configuration bundle. Having everything as bundles without artificial grouping will leverage the existing specifications for life cycle management instead of introducing a new layer since interacting life cycles are notoriously hard to make reliable and usually force one to redo the same functionality slightly different.

BLOBs are awkward to handle in configurations. If they are delivered in a bundle then the developer must extract it somewhere on the file system and set the configuration to point to that file.

4 Requirements

4.1 General

- G0010 – A solution that makes it possible to store configurations, either singleton or factory, in a bundle that are installed in Configuration Admin when that bundle is installed.
- G0020 – It must be possible to specify configurations in a system property
- G0030 – Factory configurations must be idempotent.
- G0040 – If the bundle that originated a configuration gets uninstalled then all its configurations must be deleted
- G0050 – If a bundle with configurations is updated then configurations that are already on the system must not be updated.
- G0060 – Developers must be able to indicate that a configuration must be forced updated, even if it already exists.
- G0065 – G0040-G0060 imply the need for configurations to have an update policy. The update policy must define how it interacts with the lifecycle of the bundle containing the configuration.
- G0070 – It must be possible to prevent the updating of a configuration by the runtime even the developer forced it.
- G0080 – It must be possible to include BLOBs in the configuration that are stored in the bundle but extracted to the file system.
- G0085 – BLOBs must always be updated on the file system to a different location than the previous version. This is too avoid open file lock issues on Windows file systems.
- G0090 – It must be possible to load configuration from the host bundle as well as all its fragments
- G0100 – If configurations are duplicated, the specification must define a proper order

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- G0120 – The format used to store the configuration must be a human readable text file. It should be easy to read.
- G0125 – The format must allow configuration keys to be typed. For example: “foo:Integer”:”1”.
- G0130 – The configurations must by default be usable by any bundle. That is the bundle location must be “?”
- G0150 – It must be possible to coordinate the settings of configurations, but use of the OSGi Coordinator service must be optional.
- G0160 – If the Configurator starts up, it must set all configurations that are in installed bundles at that moment in a single coordination, if the Coordinator is present. The configurations must be applied even if the coordination is failed.
- G0170 – The solution should group settings inside a coordination as much as possible. A participant must use the topmost coordination on the coordinations stack and apply configurations regardless whether the coordination failed or succeeded.
- G0180 – The solution must be able to purge configurations from uninstalled bundles even if it had not been active while they were uninstalled.
- G0190 – It must be possible in runtime to disable specific configurations.
- G0220 – Any errors must be logged
- G0230 – It must be possible to specify the configuration in multiple bundle resources. The specification must define how to resolve conflicting configurations.
- G0240 – It must be possible to specify a profile system property that can select a part of a configuration file. This will allow the same bundle to be used in different settings.
-

4.2 Configuration Admin

The Configurator has several requirements for the Configuration Admin Service. These requirements are listed in RFC 227.

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5 Technical Solution

5.1 Configuration Admin Enhancements

The Configurator Specification requires new features in Configuration Admin Service. These requirements are listed in RFC 227 and marked there as requirements for the Configurator.

5.2 Configurations

The Configurator service is a service defined by this specification to process configurations stored in a bundle.

5.2.1 osgi.implementation Capability

The Configurator implementation bundle must provide the `osgi.implementation` capability with name `osgi.configurator`. This capability can be used by provisioning tools and during resolution to ensure that a Configurator implementation is present to process the configurations. The capability must also provide the version of this specification:

```
Provide-Capability: osgi.implementation;
                    osgi.implementation="osgi.configurator";
                    version:Version="1.0"
```

This capability must follow the rules defined for the `osgi.implementation` Namespace.

5.2.2 Configurations in a Bundle

If a bundle contains configurations to be managed by the Configurator service, it must require the above mentioned capability.

```
Require-Capability: osgi.implementation;
                    filter := (&(osgi.implementation="osgi.configurator")
                                (version>=1.0)(!(version>=2.0)));
                    configurations=OSGI-INF/configurations
```

The Configurator uses `Bundle.findEntries` on the bundle requiring the above capability to find all files ending in `.~~yaml~~json` in the configured paths. Files with other endings in the configured paths are ignored. Subdirectories are not followed either. The default configured path is `OSGI-INF/configurator`. If the bundle wants to store its configurations at a different location within the bundle it can specify the attribute `configurations` on the require capability clause. The value of that attribute must be of type String or List of Strings. Each value represents a path. The path is always relative to the root of the bundle and may begin with a slash. A path value of slash indicates the root of the bundle. If a path is configured several times, it is only processed once.

If a configured path does not exist, an error should be logged with the log service if available. The found ~~YAML~~JSON files from all configured paths are processed in lexicographical order based on the full path.

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5.2.3 Configuration File Format

Each configuration file processed by the Configurator is in ~~YAML~~JSON format [10.1], UTF-8 encoded. If the contents of the file is invalid ~~YAML~~JSON, the file is ignored and an error should be logged with the log service if available.

Configuration files should declare the ~~Configurator version~~version of the JSON format they are compliant with via the ":configurator:json-version" key. If this key is omitted then version 1 is assumed. If the specified version is invalid or is not supported by the implementation, the file is ignored and an error should be logged with the log service if available. This specification defines version 1 of the ~~YAML~~JSON file format.

The overall structure of the ~~YAML~~JSON file is as follows:

```
{
    // Global Settings
    ":configurator:json-version" : 1,

    // Configurations
    "configurations": [
        {
            "service.pid": "pid.a",
            "key": "val",
            "some_number": 123,
            ":configurator:environments": ["dev","demo"]
        },
        {
            "service.pid": "pid.b",
            "a_boolean" : true
            // No environments specified, always enabled
        }
    ]
}
```

Comments are allowed within the JSON contents, they are removed before the JSON is processed as described by the JSMin algorithm [8].

```
~~# Global Settings~~
~~:configurator:version: 1# Configurations~~
~~configurations:~~
~~- pid.a:~~
~~    key: val~~
~~    some_number: 123~~
~~    :configurator:environments:~~
~~      - dev~~
~~      - demo~~

~~- pid.b:~~
~~    a_boolean: true~~
~~    # No environments specified, always enabled~~
```

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The ~~YAML~~JSON configuration~~s section~~object is a list of configuration objects. ~~The name of each configuration map is the PID of the configuration. The value is a map with the configuration properties~~Each object is a map of properties. The PID of the configuration is defined with the property “service.pid”.~~:~~

```
~~configurations:~~
~~  - my.component:~~
~~      # configuration properties~~
~~  - my.factory#foo:~~
~~      # configuration properties~~
~~  - my.factory#bar:~~
~~      # configuration properties~~
```

```
"configurations": [
  { "service.pid" : "my.component",
    // configuration properties
  },
  { "service.pid" : "my.factory~foo",
    // configuration properties
  },
  { "service.pid" : "my.factory~bar”,
    // configuration properties
  }
```

Additio~~n~~al objects in the ~~YAML~~JSON are ignored.

Properties starting with the prefix `":configurator:"` are reserved properties by the Configurator specification and might influence the processing of the configuration. These properties are filtered out by the Configurator before the properties are passed to *Configuration Admin.* The "service.pid" property is filtered out as well. All other properties of the configuration map will be used for the dictionary passed to *Configuration Admin*:

```
{
    "email" : "something@somewhere.com",
    "port" : 300,
    ":configurator:ranking~:~" : 12
}
```

The value of a configuration property for *Configuration Admin* must be the same type as the set of Primary Property Types specified in the chapter “Filter Syntax” in the OSGi Core. On the other hand, ~~YAML~~JSON only supports a basic set of scalar types (String, ~~Float~~Double, ~~Integer~~Long, and Boolean), arrays and maps. Without any further type information for the Java type, the mapping between the ~~YAML~~JSON type and the Java type is as follows:

YAML Type	Java Type
String	String
~~Integer~~Long	Long
~~Float~~Double	Double
Boolean	Boolean
Array of String	String[]
Array of ~~Integer~~Long	~~Integer~~Long[]
Array of ~~Float~~Double	~~Float~~Double[]

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Array of Boolean	Boolean[]
Anything else	String containing the ~~YAML~~JSON

The Java type of a property for the configuration object can be specified as part of the property name by appending a colon followed by the Java type. The allowed types are: the scalar types (String, Integer, Long, Float, Double, Byte, Short, Character, and Boolean), the primitive types (int, long, float, double, byte, short, char, boolean), arrays of a scalar or a primitive type and collections of the scalar types. If any other type is specified, the configuration is ignored and this should be logged as an error with the log service if available. For collections, the Configurator picks a suitable implementation which preserves the order.

```
{
    "port:Integer" : 300,
    "an.int.array:int[]" : [2, 3, 4],
    "an.Integer.collection:Collection<Integer>" : [2,3,4],
    "complex": {
      "a" : 1,
      "b" : "two"
    }
}
```

For the actual type conversion, the conversion follows the rules as outlined in RFC 215 Object Conversion.

5.2.4 Binaries

A configuration property can reference a binary. The property is declared with the type binary, the value is a path to a file. The path is always relative to the root of the bundle and may begin with a slash. The file contents is get using getEntry on the bundle containing the configuration.

```
Configurations: [{
  "service.pid" : "my.config",
  "a.file:binary" : "/OSGI-INF/files/myfile.cfg"
}]
```

The files are extracted by the Configurator. They are put in a public file area. The Configurator calls BundleContext.getFrameworkProperty("configurator.~~directory~~binaries"). The value of this property must be an absolute path. If specified, the Configurator tries to use it as the location for storing the binaries. If the specified value is not a valid file path or the Configurator can't create a directory at this location, an error is logged with the LogService and the default is used. The default is also used if no value is specified for the property. The path defaults to a directory named "binaries" within the bundle data area of the Configurator bundle.

If the Configurator runs with security enabled, the Configurator must be granted read/write permission for this directory and all bundles which take a binary as a configuration must be granted read permission to this directory.

If a configuration with a binary is added to Configuration Admin, the file is extracted from the bundle by the Configurator and copied to the local file system, creating a new file in the above mentioned directory. The value of the property is replaced with the full path to the file. Each time a file is extracted to the file system, a new file name is used to avoid open file lock issues on Windows. However the file might be shared by different bundles sharing a configuration. The Configurator does not know who the clients are and how many clients of a configuration exist.

The type of such a property might also be an array of binaries (binary[]). In this case the value of the property will be an array of paths. All files are extracted to the file system and the value of the property will be an array of strings containing the full paths of the files in the same order.

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If extracting of a file to the file system fails, this is logged as an error with the log service if available. The configuration is ignored.

If a bundle with a binary is updated, in general there is no way for the Configurator to detect whether the contents of the referenced binary is different other than extracting it and comparing it to the existing binary.

A binary file is deleted if it's not referenced by a configuration anymore. This either happens when the configuration is deleted on Configuration Admin or when the configuration is updated removing or replacing such a property.

5.2.5 Environments

In some cases it is handy to have different configurations based on the environment the instance is running in. Typical scenarios are different configurations during development, for testing and in production. The Configurator gets the active environments by calling `BundleContext#getProperty("configurator.environment")` on the bundle context of the Configurator bundle.

The value must be a comma separated string of the active environments. An identifier of an environment must follow the *token* definition from the OSGi Core chapter. ~~To support environments from multiple parties reverse DNS should be used to define environment names~~. If the property contains invalid characters, it will be ignored and logged as an error with the log service if available. Whitespace characters before and after each environment in the property value are ignored. Duplicate entries are removed, building a set of active environments. Configurations can specify the environments that they are active in using the `:configurator:environments` key. If a configuration does not specify the `:configurator:environments` key it is always applied. The value of this property is converted to a String array (as explained above). Each value in the array represents an environment name. If at least one of the mentioned environments is active, the configuration is applied.

To support different configurations depending on the environment, a configuration for the same PID might appear several times in the list of configurations

```
configurations: [
  {
    "service.pid" : "my.service.pid",
    "foo" : 1,
    ":configurator:environments" : "test"
  },
  {
    "service.pid" : "my.service.pid",
    "foo" : 2,
    ":configurator:environments" : "prod"
  },
  {
    "service.pid" : "my.service.pid",
    "foo" : 100
  }
]
```

```
~~configurations:~~
~~  - my.service.pid:~~
~~      foo: 1~~
~~      :configurator:environments: test~~
```

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~~- my.service.pid:~~
~~foo: 2~~
~~:configurator:environments: prod~~

~~- my.service.pid:~~
~~foo: 100~~

If more than one configuration for a PID can be applied, the one with the highest configuration ranking (see below) is applied. All others are ignored for this PID. If two configurations have the same ranking, the first one found is used. In the example above all configurations have the same ranking. If the environment “test” is active, the first configuration is used, if “prod” is active, the second configuration is used and if neither “test” nor “prod” are active, the third configuration is used. If both “test” and “prod” are active, again the first configuration is used.

5.2.6 Configuration Ranking

Bundles are processed sequentially by the Configurator. It is undefined in which order the bundles are processed by the Configurator. To better control the situation where more than one bundle provides a configuration for the same PID and ensure a predictable and reproducible system configuration, configurations have a configuration ranking.

The configuration ranking is modeled after the service ranking: it is an integer which defaults to 0. If two bundles have a configuration with the same PID, the configuration with the higher ranking is preferred (see below). If these two configurations have the same ranking, the configuration from the bundle with the lower bundle id is ranked higher.

The configuration ranking can be set through the property `:configurator:ranking`. The type of the property is converted to an Integer (as defined by the Object Converter specification). If the value can't be converted, it is set to 0. This case should be logged as a warning with the log service if available.

5.2.7 Configurations from the Runtime Environment

When the Configurator service starts, it calls `BundleContext#getProperty("configurator.initial")` on the bundle context of the Configurator implementation to get a configuration from the environment. If a value for this property is available and ~~consists of several lines~~starts with a curly bracket, ignoring leading white spaces, it is interpreted as literal ~~YAML~~JSON, otherwise it is interpreted as a comma-separated list of URLs. The Configurator will try to resolve the URLs and read a ~~YAML~~JSON object from each URL. If a URL can't be resolved or any error occurs during reading from that URL, an error should be logged with the log service if available and this URL is ignored. The ~~YAML~~JSON files are processed in the order of the URLs.

If the read ~~YAML~~JSON is valid as defined in this specification, ~~this~~the contained configuration is applied by the Configurator. If the ~~YAML~~JSON is invalid, an error should be logged with the log service if available. The encoding of the ~~YAML~~JSON files read through the URLs is assumed to be UTF-8.

The ranking of these configurations can be set in the ~~YAML~~JSON as outlined above, the bundle id for the configurations from the environment is set to -1. The list of configurations is treated like any other bundle configuration and accordingly applied on startup of the Configurator.

If the framework is restarted, the Configurator needs to check whether the provided configuration from the environment is different than on the previous startup. The implementation is free to use whatever is appropriate to perform this check, like comparing last modified for the URL based ~~YAML~~JSON or a hash etc. If the provided configuration is different than on a previous startup, this is treated like a bundle update with a different configuration.

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5.2.8 Overwrite policies

Each configuration is processed according to its configuration ranking and policy. The policy can be defined with the property `:configurator:policy`. Allowed values are `default` and `force`. If no property is specified or an invalid value is specified, default is used. If the value is invalid, an error should be logged.

The configuration is applied according to the following table:

	Policy **default**	Policy **force**
No configuration in config admin	Configuration is added	Configuration is added
Configuration added by Configurator: - with higher ranking - lower ranking, unchanged (*) - lower ranking, changed (*)	 No action Configuration is added No action	 No action Configuration is added Configuration is added
Configuration not added by Configurator	No action	Configuration is added

(*) If the Configurator adds a configuration to *Configuration Admin*, it keeps track of the change count. Comparing the current change count with the stored change count allows to find out, whether the configuration has been changed from outside of the Configurator.

If a configuration is added to the *Configuration Admin*, it replaces a potentially existing configuration with the same PID. If the configuration is locked, the configuration is ignored and this situation should be logged as a warning with the log service if available. If the Configurator gets an IllegalStateException while trying to update an existing configuration, this means the configuration has been removed in the meantime. In this case the Configurator tries to create the configuration. If that fails, the configuration is ignored and this is logged as an error with the log service if available. If any other exception occurs while creating, updating or deleting a configuration, this is logged as an error with the log service if available.

If a new configuration is added, the bundle location is set to “?”. The bundle location of existing configurations is not altered.

The Configurator keeps the set of configurations together with the last modified time of the bundle and the change count of added configurations.

5.2.8.1 Removing Configurations

When the Configurator removes configurations for a bundle, the Configurator uses the calculated set of configurations. Each configuration is processed according to its policy:

	Policy **default**	Policy **force**
Configuration added by Configurator - unchanged (*) - changed (*)	 Remove, add configuration with lower ranking if available No action	 Remove, add configuration with lower ranking if available Remove, add configuration with lower ranking if available

The Configurator removes all internal state for that bundle.

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5.3 Processing Bundles

The Configurator service is active if the implementation bundle is running and the implementation has access to a *Configuration Admin* service. Therefore the Configurator should require the *Configuration Admin* service through a service capability.

When the Configurator service is started, it processes all installed bundles and applies the configurations. The Configurator also checks whether a processed bundle from a previous run has been uninstalled. In that case it removes the configurations installed from this bundle according to the policy. The check can be done by simply checking if a bundle with a given bundle id is not present in the framework anymore.

While the service is running, when a bundle ~~t~~gets installed, the Configurator applies the contained configurations. If a bundle is updated, the Configurator will process the updated bundle as well. If a bundle gets uninstalled, the Configurator removes the configurations installed from this bundle according to the policy.

Although the Configurator operates sequentially (no parallel bundle operations, no parallel configuration operations), the Configurator might first compute the actions based on the available set of bundles and perform an optimized set of operations.

5.3.1 Applying Configurations from a Bundle

The Configurator should attempt to process as many bundles providing configurations as possible in a single pass. A set of configurations to be applied by the Configurator is built from the contents of each bundle.

If the Configurator did previously process this bundle and the set of active environments is the same as at the time when the bundle has been processed previously, it compares the last modified of the bundle with the last modified of the previous run. If it is the same, the bundle is already processed and no further step is performed.

The set of configurations defined within the bundle is calculated by respecting the current set of active environments. As defined above, all ~~YAML~~JSON files from a single bundle are processed in lexicographical order based on their full path. The files are read one after the other and a set of configurations is built up.

The PIDs are processed for active environments only. PIDs without a specified environment are always processed. If multiple configurations for a single Pid exists, the definition with the highest configuration ranking is used. In case of a tie within the same bundle, the first encountered configuration wins. Multiple configurations are not merged. The winning definition defines the entire configuration for this Pid.

Once the set of configurations for a bundle is defined, the Configurator checks whether this bundle has been processed previously. In this case, the Configurator compares the set from the old run with the new calculated set. If the old set contains configurations with a PID which is not in the new set, these old configurations are removed according to their policy. All configurations from the new set are applied. For each configuration in the resulting set the following is checked:

1. If this PID was set before by the Configurator, the Configurator checks whether the change count is still the same as when it was previously set. If the change count is different and the policy is not set to **`force`** this PID is not set in *Configuration Admin*.
2. The remaining set of configurations is set in *Configuration Admin* in alphabetical order.

5.3.2 Coordinator Support

If a Coordinator service is available, the Configurator must make use of it. In this case, the Configurator checks whether there is an implicit coordination available. If it exists, the Configurator adds itself as a participant to this coordination. If there is no implicit coordination, the coordinator starts a new coordination and ends it, once the Configurator is done with the currently available set of bundles containing configurations for the Configurator. If the coordination fails, the Configurator does not revert its actions.

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5.4 Standalone Configurations

The configuration file format in section 5.2.3 defines a portable representation of configurations in *Configuration Admin*. Whilst the Configurator extender implementation is necessary to process these configurations when they are packaged inside a bundle, these files can also offer significant value to other tools for deployment and management when standalone.

For example:

1. A deployer wishes to install an OSGi Application subsystem, which requires configuration to run. Currently the deployer would have to provide configuration as a separate step, in some provider specific way. With the addition of a standard configuration format the configuration(s) can be included inside the ESA, or referenced from an external repository. The subsystems implementation can then deploy the configuration into the scope of the Application Subsystem at the same time as deploying the application bundles.

2. A runtime assembly tool wishes to package and deploy an OSGi framework, a set of bundles, and one or more configurations into a single executable JAR file. The bundles to be packaged are located in an OSGi repository. In order for the tool to successfully resolve and assemble the runtime it needs to know:

   a) Does a bundle require configuration for a particular PID?

   b) What PIDs are offered by the other resources in the repository?

5.4.1 Configuration capabilities

In order to support the various configuration use cases it is necessary to define requirements and capabilities for the Configurator, the configurations, and the configuration bundles.

For configuration bundles the requirements and capabilities must be provided using the standard Require-Capability and Provide-Capability headers in the manifest file. Configuration files do not have a location to add requirement and capability metadata, therefore the metadata must be automatically generated by the repository if a standalone configuration file is added.

5.4.1.1 Common Requirements and Capabilities

Both configuration files and configuration bundles offer configuration for one or more PIDS. This capability is modeled using the `osgi.configuration` namespace. Configuration files and bundles should define Capabilities for each configuration that they define, and each capability should have resolve time effectiveness.

The osgi.configuration namespace:

Attribute	Required	Default Value	Purpose
service.pid	No	N/A	Defines the PID of the configuration
service.factoryPid	No	N/A	Defines the factory PID if this is a factory configuration

Note that at least one of service.pid and service.factorypid must be defined. If the configuration is a standard configuration then only the service.pid is used. If the configuration is a factory configuration with an automatically generated identity then only the service.factoryPid is used. If the configuration is a factory configuration with a specified identity then both the service.pid and service.factoryPid are used.

In order for configurations to be deployed it is necessary for there to be an active ConfigurationAdmin implementation. It is therefore important that the configuration files specify the following requirement:

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```
Require-Capability:
osgi.implementation;filter:="(&(osgi.implementation=osgi.cm)
(version>=1.6)(!(version>=2)))";effective:="active"
```

The version range used in this requirement may be expanded downward if the configuration does not require features from a more recent *Configuration Admin*.

This require capability is not necessary if this is a configuration bundle which requires the Configurator as the Configurator in turn requires the *Configuration Admin*.

5.4.1.2 Standalone Configuration Capabilities

In addition to the common requirements and capabilities a standalone configuration needs to provide two other capabilities when in a repository:

1. An osgi.content capability. The OSGi content namespace is easy to automatically generate for a configuration file. The one missing value is the mime type of the configuration file, which will be defined as `application/vnd.osgi.configuration`

2. An osgi.identity capability. The osgi.identity capability requires that each resource define a symbolic name and version. Currently this metadata cannot be automatically derived from the contents of the configuration file, and would have to be based on the file name.

6 Data Transfer Objects

RFC 185 defines Data Transfer Objects as a generic means for management solutions to interact with runtime entities in an OSGi Framework. DTOs provides a common, easily serializable representation of the technology.

For all new functionality added to the OSGi Framework the question should be asked: would this feature benefit from a DTO? The expectation is that in most cases it would.

The DTOs for the design in this RFC should be described here and if there are no DTOs being defined an explanation should be given explaining why this is not applicable in this case.

This section is optional and could also be provided in a separate RFC.

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7 Javadoc

Please include Javadoc of any new APIs here, once the design has matured. Instructions on how to export Javadoc for inclusion in the RFC can be found here: https://www.osgi.org/members/RFC/Javadoc

8 Considered Alternatives

8.1 Placeholders

The following idea of placeholders for framework properties was dropped as the value gets replaced at the time of processing through the Configurator. For example on a restart with a different value, the configuration is not updated and still points to the value from the previous start. The only way to solve this in a useful way is to add support for placeholders directly into *Configuration Admin*.

Placeholders can be used in any of the values for a property. The JSON type of the property needs to be string. A placeholder is identified by the start token “${“ and the end token “}”. A start token without an end token is considered an error, and the configuration will be ignored and the error logged with the Log Service. If a string value should contain the literal “${“ it needs to escape it with a single $, like “$${“. The value between the tokens is the property key. The key must follow the definition of a symbolic name, whitespace characters before and after the key are ignored. A default value can be specified by appending the pipe character after the key followed by the default value. It is allowed to specify the empty value as the default value after the pipe character – in this case the end token is directly following the pipe character.

```
{
    "service.pid" : "web.server",
    "port:Integer" : "${server.port|80}",
    "domain" : "${server.domain}",
    "dto:my.pckage.DTO" : {
                              "a" : "${dto.a}"
                          }
}
```

The key is used to get the corresponding framework property. If a value for this key exists, this value is used as the value for the property. If no value exists for that key but a default value is specified, the default value is used. If no value exists and no default value is specified this is considered an error and this configuration is skipped and the error is logged with the Log Service.

As the value needs to be specified as a JSON string in order to use placeholders, the type of the Java property for the configuration should be provided as part of the property key if the type is different from String.

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8.2 Merging Configurations

The above described approach overwrites configurations instead of merging them. The idea behind this is that a new bundle version contains a new version of a configuration. Example:

Bundle Version 1 contains a configuration for PID A with properties a=1, b=1, and c=2 – configuration ranking is 1

Bundle Version 2 contains a configuration for PID A with properties a=2, c=2, and d=2 – configuration ranking is 2

With overwriting configurations, regardless of the order in which the bundles are installed, the final configuration will be the one from bundle version 2 without the property b.

If a merging approach would be used and version 1 is installed first, and version 2 is merged into version 1, handling the removal of property b is tricky. A pure merge would not remove property b. Therefore, depending on the order, either property b is available in *Configuration Admin* or is not.

Using overwriting makes the processing predictable and cleaner.

9 Security Considerations

Description of all known vulnerabilities this may either introduce or address as well as scenarios of how the weaknesses could be circumvented.

10 Document Support

10.1 References

[1]. Bradner, S., Key words for use in RFCs to Indicate Requirement Levels, RFC2119, March 1997.

[2]. Software Requirements & Specifications. Michael Jackson. ISBN 0-201-87712-0

[3]. http://felix.apache.org/site/apache-felix-file-install.html

[4]. http://enroute.osgi.org/services/osgi.enroute.configurer.api.html

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[6]. https://angularjs.org/
[7]. http://~~yaml~~json.org
[8]. http://crockford.com/javascript/jsmin

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10.3 Acronyms and Abbreviations

10.4 End of Document

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