Configuration for MicroProfile

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Specification: Configuration for MicroProfile

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MicroProfile Config

Architecture

This specification defines an easy to use and flexible system for application configuration. It also defines ways to extend the configuration mechanism itself via a SPI (Service Provider Interface) in a portable fashion.

Rationale

Released binaries often contain functionality which needs to behave slightly differently depending on the deployment. This might be the port numbers and URLs of REST endpoints to talk to (e.g. depending on the customer for whom a WAR is deployed). Or it might even be whole features which need to be switched on and off depending on the installation. All this must be possible without the need to re-package the whole application binary.

MicroProfile Config provides a way to achieve this goal by aggregating configuration from many different ConfigSources and presents a single merged view to the user. This allows the application to bundle default configuration within the application. It also allows to override the defaults from outside, e.g. via an environment variable a Java system property or via a container like Docker. MicroProfile Config also allows to implement and register own configuration sources in a portable way, e.g. for reading configuration values from a shared database in an application cluster.

Internally, the core MicroProfile Config mechanism is purely String/String based. Type-safety is intentionally only provided on top of that by using the proper Converters before handing the value out to the caller.

The configuration key might use dot-separated blocks to prevent name conflicts. This is similar to Java package namespacing:

```
com.acme.myproject.someserver.url = http://some.server/some/endpoint
com.acme.myproject.someserver.port = 9085
com.acme.myproject.someserver.active = true
com.acme.other.stuff.name = Karl
com.acme.myproject.notify.onerror=karl@mycompany,sue@mcompany
some.library.own.config=some value
```

TIP while the above example is in the java property file syntax the actual content could also e.g. be read from a database.

Config Usage Examples

An application can obtain it's configuration programmatically via the `ConfigProvider`. In CDI enabled beans it can also get injected via `@Inject Config`. An application can then access its configured values via this `Config` instance.

Simple Programmatic Example

```
public class ConfigUsageSample {

    public void useTheConfig() {
        // get access to the Config instance
        Config config = ConfigProvider.getConfig();

        String serverUrl = config.getValue("acme.myprj.some.url", String.class);

        callToServer(serverUrl);
    }
}
```

If you need to access a different server then you can e.g. change the configuration via a Java `-D` system property:

```
$> java -Dacme.myprj.some.url=http://other.server/other/endpoint -jar some.jar
```

Note that this is only one example how to possibly configure your application. Another example is to register Custom ConfigSources to e.g. pick up values from a database table, etc.

If a config value is a comma(`,`) separated string, this value can be automatically converted to a multiple element array with `\` as the escape character. When specifying the property `myPets=dog,cat,dog\\,cat` in a config source, the following code snippet can be used to obtain an array.

```
String[] myPets = config.getValue("myPets", String[].class);
//myPets = {"dog", "cat", "dog,cat"}
```

Simple Dependency Injection Example

MicroProfile Config also provides ways to inject configured values into your beans using the `@Inject` and the `@ConfigProperty` qualifier. The `@Inject` annotation declares an injection point. When using this on a passivation capable bean, refer to CDI Specification for more details on how to make the injection point to be passivation capable.

```
@ApplicationScoped
public class InjectedConfigUsageSample {

    @Inject
    private Config config;

    //The property myprj.some.url must exist in one of the configsources, otherwise a
    //DeploymentException will be thrown.
    @Inject
    @ConfigProperty(name="myprj.some.url")
    private String someUrl;

    //The following code injects an Optional value of myprj.some.port property.
    //Contrary to natively injecting the configured value this will not lead to a
    //DeploymentException if the configured value is missing.
    @Inject
    @ConfigProperty(name="myprj.some.port")
    private Optional<Integer> somePort;

    //Injects a Provider for the value of myprj.some.dynamic.timeout property to
    //resolve the property dynamically. Each invocation to Provider#get() will
    //resolve the latest value from underlying Config.
    //The existence of configured values will get checked during startup.
    //Instances of Provider<T> are guaranteed to be Serializable.
    @Inject
    @ConfigProperty(name="myprj.some.dynamic.timeout", defaultValue="100")
    private javax.inject.Provider<Long> timeout;
    //The following code injects an Array, List or Set for the `myPets` property,
    //where its value is a comma separated value ( myPets=dog,cat,dog\\,cat)
    @Inject @ConfigProperty(name="myPets") private String[] myArrayPets;
    @Inject @ConfigProperty(name="myPets") private List<String> myListPets;
    @Inject @ConfigProperty(name="myPets") private Set<String> mySetPets;
}
```

Accessing or Creating a certain Configuration

For using MicroProfile Config in a programmatic way the `ConfigProvider` class is the central point to access a configuration. It allows access to different configurations (represented by a `Config` instance) based on the application in which it is used. The `ConfigProvider` internally delegates through to the `ConfigProviderResolver` which contains more low-level functionality.

There are 4 different ways to create a `Config` instance:

- In CDI managed components, a user can use `@Inject` to access the current application configuration. The default and the auto discovered ConfigSources will be gathered to form a configuration. The default and the auto discovered Converters will be gathered to form a configuration. Injected instance of `Config` should behave the same as the one retrieved by `ConfigProvider.getConfig()`. Injected config property values should be the same as if retrieved from an injected `Config` instance via `Config.getValue()`.
- A factory method `ConfigProvider#getConfig()` to create a `Config` object based on automatically picked up `ConfigSources` of the Application identified by the current Thread Context ClassLoader classpath. The default and the auto discovered Converters will be gathered to form a configuration. Subsequent calls to this method for a certain Application will return the same `Config` instance.
- A factory method `ConfigProvider#getConfig(ClassLoader forClassLoader)` to create a `Config` object based on automatically picked up `ConfigSources` of the Application identified by the given ClassLoader. The default and the auto discovered Converters will be gathered to form a configuration. This can be used if the Thread Context ClassLoader does not represent the correct layer. E.g. if you need the Config for a class in a shared EAR lib folder. Subsequent calls to this method for a certain Application will return the same `Config` instance.
- A factory method `ConfigProviderResolver#getBuilder()` to create a `ConfigBuilder` object. The builder has no config sources. Only the default converters are added. The `ConfigBuilder` object can be filled manually via methods like `ConfigBuilder#withSources(ConfigSources… sources)`. This configuration instance will by default not be shared by the `ConfigProvider`. This method is intended be used if a IoC container or any other external Factory can be used to give access to a manually created shared `Config`.
  - Create a builder:

    ```
    ConfigProviderResolver resolver = ConfigProviderResolver.instance();
    ConfigBuilder builder = resolver.getBuilder();
    ```

  - Add config sources and build:

    ```
    Config config =
    builder.addDefaultSources().withSources(mySource).withConverters(myConverter).bu
    ild;
    ```

- (optional) Manage the lifecycle of the config

```
resolver.registerConfig(config, classloader);
resolver.releaseConfig(config);
```

The `Config` object created via builder pattern can be managed as follows:

- A factory method `ConfigProviderResolver#registerConfig(Config config, ClassLoader classloader)` can be used to register a `Config` within the application. This configuration instance **will** be shared by `ConfigProvider#getConfig()`. Any subsequent call to `ConfigProvider#getConfig()` will return the registered `Config` instance for this application.
- A factory method `ConfigProviderResolver#releaseConfig(Config config)` to release the `Config` instance. This will unbind the current `Config` from the application. The ConfigSources that implement the `java.io.Closeable` interface will be properly destroyed. The Converters that implement the `java.io.Closeable` interface will be properly destroyed. Any subsequent call to `ConfigProvider#getConfig()` or `ConfigProvider#getConfig(ClassLoader forClassLoader)` will result in a new `Config` instance.

All methods in the `ConfigProvider`, `ConfigProviderResolver` and `Config` implementations are thread safe and reentrant.

The `Config` instances created via CDI are `Serializable`.

If a `Config` instance is created via `@Inject Config` or `ConfigProvider#getConfig()` or via the builder pattern but later called `ConfigProviderResolver#registerConfig(Config config, Classloader classloader)`, the `Config` instance will be released when the application is closed.

ConfigSources

A `ConfigSource` is exactly what its name says: a source for configured values. The `Config` uses all configured implementations of `ConfigSource` to look up the property in question.

ConfigSource Ordering

Each `ConfigSource` has a specified `ordinal`, which is used to determine the importance of the values taken from the associated `ConfigSource`. A higher `ordinal` means that the values taken from this `ConfigSource` will override values from lower-priority ConfigSources. This allows a configuration to be customized from outside a binary, assuming that external `ConfigSource` s have higher `ordinal` values than the ones whose values originate within the release binaries.

It can also be used to implement a drop-in configuration approach. Simply create a jar containing a `ConfigSource` with a higher ordinal and override configuration values in it. If the jar is present on the classpath then it will override configuration values from ConfigSources with lower `ordinal` values.

Manually defining the Ordinal of a built-in ConfigSource

Note that a special property `config_ordinal` can be set within any built-in `ConfigSource` implementation. The default implementation of `getOrdinal()` will attempt to read this value. If found and a valid integer, the value will be used. Otherwise the respective default value will be used.

```
config_ordinal = 120
com.acme.myproject.someserver.url = http://more_important.server/some/endpoint
```

Default ConfigSources

A MicroProfile Config implementation must provide ConfigSources for the following data out of the box:

- System properties (default ordinal=400).
- Environment variables (default ordinal=300).
- A `ConfigSource` for each property file `META-INF/microprofile-config.properties` found on the classpath. (default ordinal = 100).

Environment Variables Mapping Rules

Some operating systems allow only alphabetic characters or an underscore, `_`, in environment variables. Other characters such as `.`, `/`, etc may be disallowed. In order to set a value for a config property that has a name containing such disallowed characters from an environment variable, the

following rules are used.

The `ConfigSource` for the environment variables searches three environment variables for a given property name (e.g. `com.ACME.size`):

1. Exact match (i.e. `com.ACME.size`)
2. Replace each character that is neither alphanumeric nor `_` with `_` (i.e. `com_ACME_size`)
3. Replace each character that is neither alphanumeric nor `_` with `_`; then convert the name to upper case (i.e. `COM_ACME_SIZE`)

The first environment variable that is found is returned by this `ConfigSource`.

Custom ConfigSources

ConfigSources are discovered using the `java.util.ServiceLoader` mechanism.

To add a custom `ConfigSource`, implement the interface `org.eclipse.microprofile.config.spi.ConfigSource`.

```
public class CustomDbConfigSource implements ConfigSource {

    @Override
    public int getOrdinal() {
        return 112;
    }

    @Override
    public Set<String> getPropertyNames() {
        return readPropertyNames();
    }

    @Override
    public Map<String, String> getProperties() {
        return readPropertiesFromDb();
    }

    @Override
    public String getValue(String key) {
        return readPropertyFromDb(key);
    }

    @Override
    public String getName() {
        return "customDbConfig";
    }

}
```

Then register your implementation in a resource file `/META-INF/services/org.eclipse.microprofile.config.spi.ConfigSource` by including the fully-qualified class name of the custom implementation in the file.

Custom ConfigSources via ConfigSourceProvider

If you need dynamic ConfigSources you can also register a `ConfigSourceProvider` in a similar manner. This is useful if you need to dynamically pick up multiple ConfigSources of the same kind; for example, to pick up all `myproject.properties` resources from all the JARs in your classpath.

A custom `ConfigSourceProvider` must implement the interface `org.eclipse.microprofile.config.spi.ConfigSourceProvider`. Register your implementation in a resource file `/META-INF/services/org.eclipse.microprofile.config.spi.ConfigSourceProvider` by including the fully-qualified class name of the custom implementation/s in the file.

An example which registers all YAML files with the name `exampleconfig.yaml`:

```
public class ExampleYamlConfigSourceProvider
        implements org.eclipse.microprofile.config.spi.ConfigSourceProvider {
    @Override
    public List<ConfigSource> getConfigSources(ClassLoader forClassLoader) {
        List<ConfigSource> configSources = new ArrayList<>();

        Enumeration<URL> yamlFiles
            = forClassLoader.getResources("sampleconfig.yaml");
        while (yamlFiles.hasMoreElements()) {
            configSources.add(new SampleYamlConfigSource(yamlFiles.nextElement()));
        }
        return configSources;
    }
}
```

Please note that a single `ConfigSource` should be either registered directly or via a `ConfigSourceProvider`, but never both ways.

Cleaning up a ConfigSource

If a `ConfigSource` implements the `java.lang.AutoCloseable` interface then the `close()` method will be called when the underlying `Config` is being released.

ConfigSource and Mutable Data

A `Config` instance provides no caching but iterates over all `ConfigSources` for each `getValue(String)` operation. A `ConfigSource` is allowed to cache the underlying values itself.

Converter

For providing type-safe configuration we need to convert from the configured Strings into target types. This happens by providing `Converter`s in the `Config`.

Built-in Converters

The following `Converter`s are provided by MicroProfile Config by default:

- `boolean` and `java.lang.Boolean` , values for `true` (case insensitive) "true", "1", "YES", "Y" "ON". Any other value will be interpreted as `false`
- `byte` and `java.lang.Byte`
- `short` and `java.lang.Short`
- `int` and `java.lang.Integer`
- `long` and `java.lang.Long`
- `float` and `java.lang.Float` , a dot '.' is used to separate the fractional digits
- `double` and `java.lang.Double` , a dot '.' is used to separate the fractional digits
- `char` and `java.lang.Character`
- `java.lang.Class` based on the result of `Class.forName`

All built-in `Converter`s have the `@Priority` of `1`.

Adding custom Converters

A custom `Converter` must implement the generic interface `org.eclipse.microprofile.config.spi.Converter`. The Type parameter of the interface is the target type the String is converted to. You have to register your implementation in a file `/META-INF/services/org.eclipse.microprofile.config.spi.Converter` with the fully qualified class name of the custom implementation.

A custom `Converter` can define a priority with the `@javax.annotation.Priority` annotation. If a Priority annotation isn't applied, a default priority of 100 is assumed. The `Config` will use the `Converter` with the highest `Priority` for each target type.

A custom `Converter` for a target type of any of the built-in Converters will overwrite the default Converter.

Converters can be added to the `ConfigBuilder` programmatically via `ConfigBuilder#withConverters(Converter<?>... converters)` where the type of the converters can be obtained via reflection. However, this is not possible for a lambda converter. In this case, use the method `ConfigBuilder#withConverter(Class<T> type, int priority, Converter<T> converter)`.

Array Converters

For the built-in converters and custom converters, the corresponding Array converters are provided by default. The delimiter for the config value is ",". The escape character is "\". e.g. With this config `myPets=dog,cat,dog\,cat`, the values as an array will be `{"dog", "cat", "dog,cat"}`.

Programmatic lookup

Array as a class type is supported in the programmatic lookup.

```
String[] myPets = config.getValue("myPets", String[].class);
```

myPets will be "dog", "cat", "dog,cat" as an array

Injection model

For the property injection, Array, List and Set are supported.

```
@Inject @ConfigProperty(name="myPets") String[] myPetsArray;
@Inject @ConfigProperty(name="myPets") List<String> myPetsList;
@Inject @ConfigProperty(name="myPets") Set<String> myPetsSet;
```

myPets will be "dog", "cat", "dog,cat" as an array, List or Set.

Automatic Converters

If no built-in nor custom `Converter` exists for a requested Type `T`, an implicit `Converter` is automatically provided if the following conditions are met:

- The target type `T` has a `public static T of(String)` method, or
- The target type `T` has a `public static T valueOf(String)` method, or
- The target type `T` has a `public static T parse(CharSequence)` method, or
- The target type `T` has a public Constructor with a `String` parameter

Cleaning up a Converter

If a `Converter` implements the `java.lang.AutoCloseable` interface then the `close()` method will be called when the underlying `Config` is being released.

Release Notes for MicroProfile Config 1.1

The following changes occurred in the 1.1 release, compared to 1.0

A full list of changes may be found on the MicroProfile Config 1.1 Milestone

API/SPI Changes

- The `ConfigSource` SPI has been extended with a default method that returns the property names for a given `ConfigSource` (#178)

Functional Changes

- Implementations must now include a `URL` Converter, of `@Priority(1)` (#181)
- The format of the default property name for an injection point using `@ConfigProperty` has been changed to no longer lower case the first letter of the class. Implementations may still support this behavior. Instead, MicroProfile Config 1.1 requires the actual class name to be used. (#233)
- Implementations must now support primitive types, in addition to the already specified primtive type wrappers (#204)

Specification Changes

- Clarified what it means for a value to be present (#216)

Release Notes for MicroProfile Config 1.2

The following changes occurred in the 1.2 release, compared to 1.1

A full list of changes may be found on the MicroProfile Config 1.2 Milestone

API/SPI Changes

- The `ConfigBuilder` SPI has been extended with a method that allows for a converter with the specified class type to be registered (#205). This change removes the limitation, which was unable to add a lambda converter, from the previous releases.

Functional Changes

- Implementations must now support the array converter (#259). For the array converter, the programmatic lookup of a property (e.g. `config.getValue(myProp, String[].class)`) must support the return type of the array. For the injection lookup, an Array, List or Set must be supported as well (e.g. `@Inject @ConfigProperty(name="myProp") private List<String> propValue;`).
- Implementations must also support the common sense converters (#269) where there is no corresponding type of converters provided for a given class. The implementation must use the class's constructor with a single string parameter, then try `valueOf(String)` followed by `parse(CharSequence)`.
- Implementations must also support Class converter (#267)

Specification Changes

- Specification changes to document (#205), (#259), (#269) (#267)

Other Changes

The API bundle can work with either CDI 1.2 or CDI 2.0 in OSGi environment (#249).

A tck test was added to ensure the search path of `microprofile-config.properties` for a `war` archive is `WEB-INF\classes\META-INF` (#268)

Release Notes for MicroProfile Config 1.3

The following changes occurred in the 1.3 release, compared to 1.2

A full list of changes may be found on the MicroProfile Config 1.3 Milestone

API/SPI Changes

No API/SPI changes.

Functional Changes

- The implicit (common sense) converters have been improved and some of the built-in converters are removed from the spec as they are covered by implicit converters. The method invocation sequence on implicit converters are further improved (#325).
- Implementations must also support the mapping of a config property to the corresponding environment variable (#264)

Specification Changes

- Specification changes to document (#348), (#325), (#264)

Other Changes

More CTS were added:

- Assert URI will be converted (#322)
- Testing injecting an Optional<String> that has no config value (#336).
- Built-in converters are automatically added to the injected config ((#348)

Java2 security related change (#343)

Release Notes for MicroProfile Config 1.4

A full list of changes delivered in the 1.4 release can be found at MicroProfile Config 1.4 Milestone.

API/SPI Changes

- Prevent incorrect caching of ConfigProviderResolver (#265)
- ConfigProviderResolver classloading issues (#450) (#390)
- Converter extends Serializable (#473)

Spec Changes

- Change the priority of implicit converters (#383)
- Clarify if @ConfigProperty injected values are bean passivating enabled (#404)
- Add built-in converters for byte, short and char (#386)

Other Changes

- Exclude EL api transitive dependency (#440)
- Other minor spec wording or JavaDoc updates