



OSGiTM
Alliance

RFC 185 Data Transfer Objects

Final

51 Pages

Abstract

Define a set of data-only objects to represent runtime objects. The types will have limited behavior to support easy serialization and use by management agents to communicate with external systems.

0 Document Information

0.1 License

DISTRIBUTION AND FEEDBACK LICENSE, Version 2.0

The OSGi Alliance hereby grants you a limited copyright license to copy and display this document (the "Distribution") in any medium without fee or royalty. This Distribution license is exclusively for the purpose of reviewing and providing feedback to the OSGi Alliance. You agree not to modify the Distribution in any way and further agree to not participate in any way in the making of derivative works thereof, other than as a necessary result of reviewing and providing feedback to the Distribution. You also agree to cause this notice, along with the accompanying consent, to be included on all copies (or portions thereof) of the Distribution. The OSGi Alliance also grants you a perpetual, non-exclusive, worldwide, fully paid-up, royalty free, limited license (without the right to sublicense) under any applicable copyrights, to create and/or distribute an implementation of the Distribution that: (i) fully implements the Distribution including all its required interfaces and functionality; (ii) does 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 Distribution. An implementation that does not satisfy limitations (i)-(ii) is not considered an implementation of the Distribution, does not receive the benefits of this license, and must not be described as an implementation of the Distribution. "OSGi Name Space" shall mean the public class or interface declarations whose names begin with "org.osgi" or any recognized successors or replacements thereof. The OSGi Alliance expressly reserves all rights not granted pursuant to these limited copyright licenses including termination of the license at will at any time.

EXCEPT FOR THE LIMITED COPYRIGHT LICENSES GRANTED ABOVE, THE OSGi ALLIANCE DOES NOT GRANT, EITHER EXPRESSLY OR IMPLIEDLY, A LICENSE TO ANY INTELLECTUAL PROPERTY IT, OR ANY THIRD PARTIES, OWN OR CONTROL. Title to the copyright in the Distribution will at all times remain with the OSGi Alliance. The example companies, organizations, products, domain names, e-mail addresses, logos, people, places, and events depicted therein are fictitious. No association with any real company, organization, product, domain name, email address, logo, person, place, or event is intended or should be inferred.

THE DISTRIBUTION IS PROVIDED "AS IS," AND THE OSGi ALLIANCE (INCLUDING ANY THIRD PARTIES THAT HAVE CONTRIBUTED TO THE DISTRIBUTION) MAKES NO REPRESENTATIONS OR WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, NON-INFRINGEMENT, OR TITLE; THAT THE CONTENTS OF THE DISTRIBUTION ARE SUITABLE FOR ANY PURPOSE; NOR THAT THE IMPLEMENTATION OF SUCH CONTENTS WILL NOT INFRINGE ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADEMARKS OR OTHER RIGHTS.

NEITHER THE OSGi ALLIANCE NOR ANY THIRD PARTY WILL BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF OR RELATING TO ANY USE OR DISTRIBUTION OF THE DISTRIBUTION.

Implementation of certain elements of this Distribution may be subject to third party intellectual property rights, including without limitation, patent rights (such a third party may or may not be a member of the OSGi Alliance). The OSGi Alliance is not responsible and shall not be held responsible in any manner for identifying or failing to identify any or all such third party intellectual property rights.

The Distribution is a draft. As a result, the final product may change substantially by the time of final publication, and you are cautioned against relying on the content of this Distribution. You are encouraged to update any implementation of the Distribution if and when such Distribution becomes a final specification.

The OSGi Alliance is willing to receive input, suggestions and other feedback ("Feedback") on the Distribution. By providing such Feedback to the OSGi Alliance, you grant to the OSGi Alliance and all its Members a non-exclusive, non-transferable,

worldwide, perpetual, irrevocable, royalty-free copyright license to copy, publish, license, modify, sublicense or otherwise distribute and exploit your Feedback for any purpose. Likewise, if incorporation of your Feedback would cause an implementation of the Distribution, including as it may be modified, amended, or published at any point in the future ("Future Specification"), to necessarily infringe a patent or patent application that you own or control, you hereby commit to grant to all implementers of such Distribution or Future Specification an irrevocable, worldwide, sublicenseable, royalty free license under such patent or patent application to make, have made, use, sell, offer for sale, import and export products or services that implement such Distribution or Future Specification. You warrant that (a) to the best of your knowledge you have the right to provide this Feedback, and if you are providing Feedback on behalf of a company, you have the rights to provide Feedback on behalf of your company; (b) the Feedback is not confidential to you and does not violate the copyright or trade secret interests of another; and (c) to the best of your knowledge, use of the Feedback would not cause an implementation of the Distribution or a Future Specification to necessarily infringe any third-party patent or patent application known to you. You also acknowledge that the OSGi Alliance is not required to incorporate your Feedback into any version of the Distribution or a Future Specification.

I HEREBY ACKNOWLEDGE AND AGREE TO THE TERMS AND CONDITIONS DELINEATED ABOVE.

0.2 Trademarks

OSGi™ is a trademark, registered trademark, or service mark of the OSGi Alliance in the US and other countries. Java is a trademark, registered trademark, or service mark of Oracle Corporation in the US and other countries. All other trademarks, registered trademarks, or service marks used in this document are the property of their respective owners and are hereby recognized.

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

0 Document Information.....	2
0.1 License.....	2
0.2 Trademarks.....	3
0.3 Feedback.....	3
0.4 Table of Contents.....	3
0.5 Terminology and Document Conventions.....	4
0.6 Revision History.....	4
1 Introduction.....	5
2 Application Domain.....	6
3 Problem Description.....	6
4 Requirements.....	6
5 Technical Solution.....	7
5.1 Data Transfer Object Design.....	7
5.1.1 DTO Naming Conventions.....	7
5.1.2 Core DTOs.....	8
5.2 Obtaining Data Transfer Objects.....	9
5.2.1 Core DTOs.....	9
5.3 Examples of DTO usage.....	10
5.3.1 REST.....	10
5.3.2 JMX.....	10

5.3.3 Residential DMT.....	11
6 Javadoc.....	11
7 Considered Alternatives.....	50
7.1 Compendium DTOs.....	50
8 Security Considerations.....	50
9 Document Support.....	50
9.1 References.....	50
9.2 Author's Address.....	50
9.3 Acronyms and Abbreviations.....	51
9.4 End of Document.....	51

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 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	9 Jun 2012	Initial draft.
2 nd draft	13 Jun 2012	Updated after CPEG f2f in NYC
3 rd draft	11 Sep 2012	Added new DTOs to complete the DTOs for the Core framework.
4 th draft	24 Oct 2012	Updated based upon comments from Basel F2F.
5 th draft	29 Oct 2012	Updated based upon comments from 25 Oct 2012 CPEG call.
6 th draft	5 Nov 2012	David Bosschaert (Red Hat) adding JMX section.
7 th draft	9 Nov 2012	Updates from 6 Nov Orlando F2F.
8 th draft	5 Dec 2012	Updates for bugs 2474 (toString) and 2475 (List, Set and Map). DTO is now an abstract class with toString behavior. Serializable is also removed since it cannot be supported in the base class alone. See bug 2475.

Revision	Date	Comments
9 th draft	12 Dec 2012	<p>While implementing, it became clear that FrameworkDTO needed to be adapted from the system bundle (instead of any bundle). This because a bundle context is needed to get services. Random bundles may not have valid contexts. Also there is the issue of hooks filtering services and bundles. Limiting this to the system bundles simplifies things and ensure the same DTO view rather than an empty or filtered one.</p> <p>Javadoc also updated to indicate that some adaptations don't apply after the bundle is uninstalled.</p>
Final	3 Feb 2014	<p>Replace BundleRevisionsDTO with adapting to BundleRevisionDTO[] and BundleWiringsDTO with adapting to BundleWiringDTO[].</p> <p>Restructure wiring DTOs to remove cycles. The set of referenced DTOs is pushed up to the top level BundleWiringDTO and each DTO is assigned a transient identifier that can be used as a reference by other DTOs. An example transient identifier could be the identity hash code of the underlying runtime object. Since CapabilityDTO and RequirementDTO object can be large, due to the contained directives and attributes maps, we change to use ref DTOs in the wiring DTO types. The ref DTOs refer to the CapabilityDTO/RequirementDTO objects in the BundleRevisionDTO.</p>

1 Introduction

The OSGi API is rich and introspective. Since the API has a lot of behavior and is not designed for serialization, each management model must design its own representation of the relevant OSGi objects for transport to the remote management system. We see this in JMX, DMT and also in REST. Having standard, simple, easy to serialize and deserialize objects which represent the relevant OSGi object will make it easier for the management model to keep up with changes in the OSGi API.

2 Application Domain

While OSGi has a rich API for local management of bundles, services, etc., each management model must define how this OSGi objects are represented for communication with remote management systems. JMX must define the Mbeans, DMT must define the tree representation, REST must define the request/response payload.

The OSGi API continues to evolve and at each update of the OSGi API, the management systems will all need to update their representation of the OSGi objects.

3 Problem Description

Since each management model defines its own representation of the OSGi objects, each management model specification will need to be updated whenever some new feature is added to the OSGi API. A common, shared representation will reduce the effort needed by each management model specification to track changes the OSGi API.

4 Requirements

DTO-0001 – DTOs must be easily serializable. That is, no special serialization/deserialization logic must be required. Serialization must be possible simply by introspecting the DTO objects and object graphs must be acyclic.

DTO-0002 – DTOs must have no behavior. That is, no methods other than the default public constructor.

DTO-0003 – DTOs must have only public fields.

DTO-0004 – The types of the fields in a DTO must be one of:

- primitive numerical types or their wrapper classes (e.g. int, Long)

- boolean or Boolean
- String
- a DTO
- Arrays
- Lists
- Sets
- Maps

No other types are permitted. The aggregates (arrays, Lists, Sets and Maps) may only contain any of the allowed types including aggregates.

DTO-0005 – A DTO may extend another DTO.

DTO-0006 – A mechanism must be provided to create DTO objects for the real objects they represent.

5 Technical Solution

There are two main parts to Data Transfer Objects: the design of the data structures and how to obtain instances of the data structures from the framework or other OSGi service.

5.1 Data Transfer Object Design

A Data Transfer Object [3]. is used to capture the state of a related object in a form suitable for easy transfer to some receiver. The receiver can be in the same JVM but is more likely in another process or on another system that is remote.

All DTOs are easily serializable having only public fields of primitive types and their wrapper classes, Strings, and DTOs. List, Set, Map and array aggregates may also be used. The aggregates must only hold objects of the listed types or aggregates. All DTOs must extend the `org.osgi.dto.DTO` abstract base class. DTOs are public classes with no methods (other than the compiler supplied default constructor) having only public fields limited to the easily serializable types mentioned above.

The `org.osgi.dto` package defines the basic rules and base DTO type which is extended by other DTOs.

5.1.1 DTO Naming Conventions

DTOs should follow a naming convention for the package containing the DTO as well as the DTO type.

For the package name, DTOs should be in a package that starts with `org.osgi.dto` [In our build, these packages are all part of the `org.osgi.dto` project] and finishes with the remainder of the package name containing the type for which the DTO provides state after removing the leading `org.osgi`. So for a DTO for a type in the `org.osgi.service.foo` package, the proper DTO package name is `org.osgi.dto.service.foo`. In other words, the segment “dto” is inserted right after `org.osgi`.

The name of the DTO type should be the name of the type for which the DTO provides a snapshot of the state followed by “DTO”. So for a type `Widget`, the DTO for that type should be `WidgetDTO`. Sometime the entity for which the DTO provides state is not represented by a type; for example, `Framework`. In this case, the name of entity with a DTO suffix should be used: `FrameworkDTO`.

Putting both the package and type DTO naming conventions together: The DTO for `org.osgi.service.foo.Widget` would be `org.osgi.dto.service.foo.WidgetDTO`.

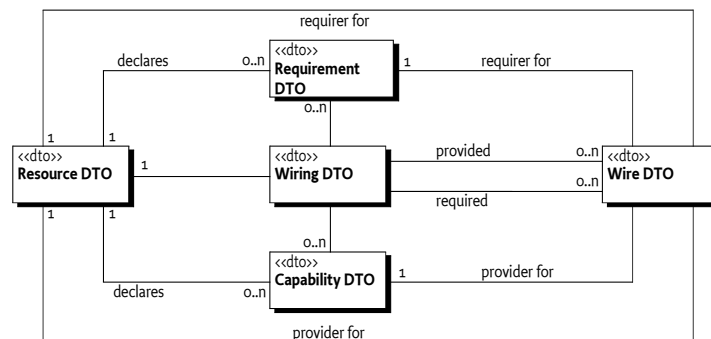
5.1.2 Core DTOs

DTOs are defined for the key framework objects: `Bundle`, “framework”, `ServiceReference`, resource types, startlevel types and wiring types.

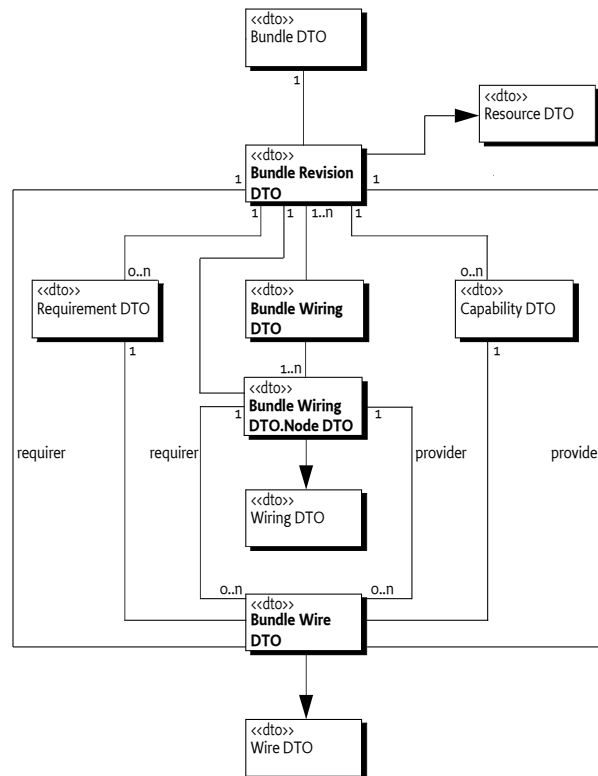
`BundleDTO` provides information about a single bundle. `FrameworkDTO` provides the list of installed bundles, the registered services and the launch properties of a single framework. `ServiceReferenceDTO` provides, for a single service, the service properties, the bundle which registered the service and the bundles using the service.

`BundleStartLevelDTO` provides the start level information about a single bundle. `FrameworkStartLevelDTO` provides the start level information about a single framework.

`CapabilityDTO`, `RequirementDTO`, `ResourceDTO`, `WiringDTO` and `WireDTO` provide the resource package equivalent view of capabilities and requirements wiring information. The following figure shows the effective relationship between the DTO types. Since the graph of Data Transfer Objects must be acyclic, some references are indirect.



BundleRevisionDTO, BundleWiringDTO, BundleWireDTO provide the wiring package equivalent view of capabilities and requirements wiring information. The following figure shows the effective relationship between the DTO types. Since the graph of Data Transfer Objects must be acyclic, some references are indirect.



5.2 Obtaining Data Transfer Objects

5.2.1 Core DTOs

The framework must supply DTO objects via Bundle.adapt.

An installed Bundle object can be adapted to: BundleDTO, ServiceReferenceDTO[], BundleStartLevelDTO, BundleRevisionDTO, BundleRevisionDTO[], BundleWiringDTO, and BundleWiringDTO[]. The System Bundle object can be adapted to: FrameworkDTO and FrameworkStartLevelDTO.

A FrameworkDTO object can be used to obtain all the BundleDTOs and ServiceReferenceDTOs for installed bundles and registered services.

For example:

```
// DTO for the bundle
BundleDTO bundleDTO = bundle.adapt(BundleDTO.class);
```

```
// DTO for the current bundle wiring
BundleWiringDTO bundleWiringDTO = bundle.adapt(BundleWiringDTO.class);

// DTO for the current bundle revision
BundleRevisionDTO bundleRevisionDTO = bundle.adapt(BundleRevisionDTO.class);
```

5.3 Examples of DTO usage

5.3.1 REST

RFC 182 defines a REST interface to the OSGi framework. The DTO objects defined in this RFC can be used to create the representations for the REST interfaces.

A REST request to get the bundle information for bundle 1 (GET framework/bundle/1) can obtain the representation information using the BundleDTO.

```
long id = getBundleIdFromURI(requestURI);
BundleDTO bundleDTO = getContext().getBundle(id).adapt(BundleDTO.class);
String response = jsonSerializer(bundleDTO); // serialize to JSON (or XML)
```

5.3.2 JMX

The JMX spec defines a JMX interface to the OSGi framework. The DTO objects defined in this RFC can be used to obtain state information to be used by the JMX MBeans.

To expose the Framework DTOs a new JMX MBean needs to be defined that provides access to these DTOs. For example:

```
public interface FrameworkMBean {
    CompositeData[] getBundles();
    CompositeData getBundle(long id);
    CompositeData[] getServices();
    // ... etc ...
}
```

Instead of the plain DTO object, JMX-OpenBean versions of the objects are provided through this API. This means that Open Type supported simple types (as defined in [javax.management.openmbean.OpenType.ALLOWED_CLASSNAMES_LIST](#)) can be used as-is, but embedded DTOs and maps need to be transformed into JMX structures, as listed in the following table:

<i>DTO data type</i>	<i>JMX data type</i>
simple type (as supported by JMX Open Types)	javax.management.openmbean.SimpleType constant
Map	TabularType
custom DTO	CompositeType
custom DTO []	CompositeType[]

Given a certain DTO, a fairly straightforward generic transformation can be defined to produce JMX friendly data structures, this can be achieved by introspecting the DTOs using Java reflection and generating CompositeType definitions and CompositeData objects from them. Composite types and Tabulary types support nesting so nested DTOs can be supported.

Non-framework DTOs

For DTOs that provide information regarding an Enterprise, Residential or other Compendium specification, root MBeans will still be necessary in the MBean registry, however these MBeans can simply provide access to JMX views over the relevant DTOs which can be automatically produced from the DTO definition.

Modifying the Framework state

The DTOs don't provide a mechanism to change the state of the framework (or any other component) so in order to support this, specific APIs still need to be provided by the JMX MBeans.

Maintenance

Using DTOs will significantly reduce the maintenance required to provide viewing capabilities into the framework and into other components that expose themselves as DTOs, as the DTO definitions can be used to generate JMX OpenBeans suitable for a JMX management agent.

Maintenance is still needed for APIs that alter the framework state.

5.3.3 Residential DMT

The Residential DMT spec defines a Device Management Tree (DMT) interface to the OSGi framework. The DTO objects defined in this RFC can be used to obtain state information to be used to populate information in the Residential DMT.

```
// $/Framework/StartLevel node value
```

```
FrameworkStartLevelDTO fsldto =  
getContext().getBundle(0).adapt(FrameworkStartLevelDTO.class);  
return new DmtData(FrameworkStartLevelDTO.startLevel);
```

6 Javadoc

OSGi Javadoc

2/3/14 2:16 PM

Package Summary		<i>Page</i>
org.osgi.dto	OSGi Data Transfer Object Package Version 1.0.	13
org.osgi.dto.framework	OSGi Data Transfer Object Framework Package Version 1.8.	15
org.osgi.dto.framework.startlevel	OSGi Data Transfer Object Framework Start Level Package Version 1.0.	22
org.osgi.dto.framework.wiring	OSGi Data Transfer Object Framework Wiring Package Version 1.2.	26
org.osgi.dto.resource	OSGi Data Transfer Object Resource Package Version 1.0.	35

Package org.osgi.dto

```
@org.osgi.annotation.versioning.Version(value="1.0")
```

OSGi Data Transfer Object Package Version 1.0.

See:

[Description](#)

Class Summary		Page
DTO	Super type for Data Transfer Objects.	14

Package org.osgi.dto Description

OSGi Data Transfer Object 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.dto; version="[1.0,2.0)"
```

Example import for providers implementing the API in this package:

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

Class DTO

[org.osgi.dto](#)

```
java.lang.Object
└─ org.osgi.dto.DTO
```

Direct Known Subclasses:

[BundleDTO](#), [BundleStartLevelDTO](#), [BundleWiringDTO](#), [CapabilityDTO](#), [CapabilityRefDTO](#),
[FrameworkDTO](#), [FrameworkStartLevelDTO](#), [RequirementDTO](#), [RequirementRefDTO](#), [ResourceDTO](#),
[ServiceReferenceDTO](#), [WireDTO](#), [WiringDTO](#)

```
abstract public class DTO
extends Object
```

Super type for Data Transfer Objects. All data transfer objects are easily serializable having only public fields of primitive types and their wrapper classes, Strings, and DTOs. List, Set, Map and array aggregates may also be used. The aggregates must only hold objects of the listed types or aggregates.

NotThreadSafe

Constructor Summary	Page
DTO ()	14

Method Summary	Page
<div>String</div> toString () Return a string representation of this DTO suitable for use when debugging.	14

Constructor Detail

DTO

```
public DTO()
```

Method Detail

toString

```
public String toString()
```

Return a string representation of this DTO suitable for use when debugging.

The format of the string representation is not specified and subject to change.

Overrides:

`toString` in class `Object`

Returns:

A string representation of this DTO suitable for use when debugging.

Package org.osgi.dto.framework

@org.osgi.annotation.versioning.Version(value="1.8")

OSGi Data Transfer Object Framework Package Version 1.8.

See:

[Description](#)

Class Summary		Page
BundleDTO	Data Transfer Object for a Bundle.	16
FrameworkDTO	Data Transfer Object for a Framework.	18
ServiceReferenceDTO	Data Transfer Object for a ServiceReference.	20

Package org.osgi.dto.framework Description

OSGi Data Transfer Object Framework Package Version 1.8.

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.dto.framework; version="[1.8,2.0]"
```

Example import for providers implementing the API in this package:

```
Import-Package: org.osgi.dto.framework; version="[1.8,1.9]"
```

Class BundleDTO

[org.osgi.dto.framework](#)

```
java.lang.Object
├─ org.osgi.dto.DTO
│   └─ org.osgi.dto.framework.BundleDTO
```

```
public class BundleDTO
extends DTO
```

Data Transfer Object for a Bundle.

A Bundle can be adapted to provide a BundleDTO for the Bundle.

NotThreadSafe

Field Summary		Page
long	id The bundle's unique identifier.	16
long	lastModified The time when the bundle was last modified.	16
int	state The bundle's state.	17
String	symbolicName The bundle's symbolic name.	17
String	version The bundle's version.	17

Constructor Summary	Page
BundleDTO()	17

Methods inherited from class org.osgi.dto. DTO
toString

Field Detail

id

```
public long id
```

The bundle's unique identifier.

lastModified

```
public long lastModified
```

The time when the bundle was last modified.

state

```
public int state
```

The bundle's state.

symbolicName

```
public String symbolicName
```

The bundle's symbolic name.

version

```
public String version
```

The bundle's version.

Constructor Detail

BundleDTO

```
public BundleDTO()
```

Class FrameworkDTO

[org.osgi.dto.framework](#)

```
java.lang.Object
├── org.osgi.dto.DTO
│   └── org.osgi.dto.framework.FrameworkDTO
```

```
public class FrameworkDTO
    extends DTO
```

Data Transfer Object for a Framework.

The System Bundle can be adapted to provide a `FrameworkDTO` for the framework of the system bundle. A `FrameworkDTO` obtained from a framework will contain only the launch properties of the framework. These properties will not include the System properties.

NotThreadSafe

Field Summary		Page
List< BundleDTO >	bundles The bundles that are installed in the framework.	18
Map<String, Object>	properties The launch properties of the framework.	18
List< ServiceReferenceDTO >	services The services that are registered in the framework.	18

Constructor Summary	Page
FrameworkDTO ()	19

Methods inherited from class org.osgi.dto.DTO
toString

Field Detail

bundles

```
public List<BundleDTO> bundles
```

The bundles that are installed in the framework.

properties

```
public Map<String, Object> properties
```

The launch properties of the framework. The value type must be a numerical type, Boolean, String, DTO or an array of any of the former.

services

```
public List<ServiceReferenceDTO> services
```

The services that are registered in the framework.

Constructor Detail

FrameworkDTO

```
public FrameworkDTO()
```

Class ServiceReferenceDTO

[org.osgi.dto.framework](#)

```
java.lang.Object
├── org.osgi.dto.DTO
│   └── org.osgi.dto.framework.ServiceReferenceDTO
```

```
public class ServiceReferenceDTO
    extends DTO
```

Data Transfer Object for a ServiceReference.

ServiceReferenceDTOs for all registered services can be obtained from a [FrameworkDTO](#). An installed Bundle can be adapted to provide a `ServiceReferenceDTO[]` of the services registered by the Bundle. A `ServiceReferenceDTO` obtained from a framework must convert service property values which are not valid value types for DTOs to type `String` using `String.valueOf(Object)`.

NotThreadSafe

Field Summary		Page
long	bundle The id of the bundle that registered the service.	20
long	id The <code>service.id</code> of the service.	20
Map<String, Object>	properties The properties for the service.	21
long[]	usingBundles The ids of the bundles that are using the service.	21

Constructor Summary	Page
ServiceReferenceDTO()	21

Methods inherited from class org.osgi.dto.DTO
toString

Field Detail

id

```
public long id
```

The `service.id` of the service.

bundle

```
public long bundle
```

The id of the bundle that registered the service.

properties

```
public Map<String,Object> properties
```

The properties for the service. The value type must be a numerical type, Boolean, String, DTO or an array of any of the former.

usingBundles

```
public long[] usingBundles
```

The ids of the bundles that are using the service.

Constructor Detail

ServiceReferenceDTO

```
public ServiceReferenceDTO()
```

Package org.osgi.dto.framework.startlevel

```
@org.osgi.annotation.versioning.Version(value="1.0")
```

OSGi Data Transfer Object Framework Start Level Package Version 1.0.

See:

[Description](#)

Class Summary		Page
BundleStartLevelDTO	Data Transfer Object for a BundleStartLevel.	23
FrameworkStartLevelDTO	Data Transfer Object for a FrameworkStartLevel.	25

Package org.osgi.dto.framework.startlevel Description

OSGi Data Transfer Object Framework Start Level 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.dto.framework.startlevel; version="[1.0,2.0)"
```

Example import for providers implementing the API in this package:

```
Import-Package: org.osgi.dto.framework.startlevel; version="[1.0,1.1)"
```

Class BundleStartLevelDTO

[org.osgi.dto.framework.startlevel](#)

```
java.lang.Object
└─ org.osgi.dto.DTO
    └─ org.osgi.dto.framework.startlevel.BundleStartLevelDTO
```

```
public class BundleStartLevelDTO
extends DTO
```

Data Transfer Object for a BundleStartLevel.

An installed Bundle can be adapted to provide a BundleStartLevelDTO for the Bundle.

NotThreadSafe

Field Summary		Page
boolean	activationPolicyUsed The bundle's autostart setting indicates that the activation policy declared in the bundle manifest must be used.	24
long	bundle The id of the bundle associated with this start level.	23
boolean	persistentlyStarted The bundle's autostart setting indicates it must be started.	24
int	startLevel The assigned start level value for the bundle.	23

Constructor Summary	Page
BundleStartLevelDTO()	24

Methods inherited from class org.osgi.dto.DTO
toString

Field Detail

bundle

```
public long bundle
```

The id of the bundle associated with this start level.

startLevel

```
public int startLevel
```

The assigned start level value for the bundle.

activationPolicyUsed

```
public boolean activationPolicyUsed
```

The bundle's autostart setting indicates that the activation policy declared in the bundle manifest must be used.

persistentlyStarted

```
public boolean persistentlyStarted
```

The bundle's autostart setting indicates it must be started.

Constructor Detail

BundleStartLevelDTO

```
public BundleStartLevelDTO()
```


Class FrameworkStartLevelDTO

[org.osgi.dto.framework.startlevel](#)

```
java.lang.Object
├── org.osgi.dto.DTO
│   └── org.osgi.dto.framework.startlevel.FrameworkStartLevelDTO
```

```
public class FrameworkStartLevelDTO
extends DTO
```

Data Transfer Object for a FrameworkStartLevel.

The System Bundle can be adapted to provide a `FrameworkStartLevelDTO` for the framework of the Bundle.

NotThreadSafe

Field Summary		Page
int	initialBundleStartLevel The initial start level value that is assigned to a bundle when it is first installed.	25
int	startLevel The active start level value for the framework.	25

Constructor Summary	Page
FrameworkStartLevelDTO ()	25

Methods inherited from class <code>org.osgi.dto.DTO</code>
toString

Field Detail

startLevel

```
public int startLevel
```

The active start level value for the framework.

initialBundleStartLevel

```
public int initialBundleStartLevel
```

The initial start level value that is assigned to a bundle when it is first installed.

Constructor Detail

FrameworkStartLevelDTO

```
public FrameworkStartLevelDTO ()
```

Package org.osgi.dto.framework.wiring

```
@org.osgi.annotation.versioning.Version(value="1.2")
```

OSGi Data Transfer Object Framework Wiring Package Version 1.2.

See:

[Description](#)

Class Summary		Page
BundleRevisionDTO	Data Transfer Object for a BundleWiring.	27
BundleWireDTO	Data Transfer Object for a BundleWire.	29
BundleWiringDTO	Data Transfer Object for a BundleWiring graph.	31
BundleWiringDTO.NodeDTO	Data Transfer Object for a BundleWiring node.	33

Package org.osgi.dto.framework.wiring Description

OSGi Data Transfer Object Framework Wiring Package Version 1.2.

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.dto.framework.wiring; version="[1.2,2.0)"
```

Example import for providers implementing the API in this package:

```
Import-Package: org.osgi.dto.framework.wiring; version="[1.2,1.3)"
```

Class BundleRevisionDTO

[org.osgi.dto.framework.wiring](#)

```
java.lang.Object
├─ org.osgi.dto.DTO
│   └─ org.osgi.dto.resource.ResourceDTO
│       └─ org.osgi.dto.framework.wiring.BundleRevisionDTO
```

```
public class BundleRevisionDTO
extends ResourceDTO
```

Data Transfer Object for a BundleWiring.

An installed Bundle can be adapted to provide a BundleRevisionDTO for the current revision of the Bundle. BundleRevisionDTO objects for all in use revisions of the Bundle can be obtained by adapting the bundle to BundleRevisionDTO[].

NotThreadSafe

Field Summary		Page
long	bundle The id of the bundle associated with the bundle revision.	28
String	symbolicName The symbolic name of the bundle revision.	27
int	type The type of the bundle revision.	27
String	version The version of the bundle revision.	28

Fields inherited from class org.osgi.dto.resource. ResourceDTO
capabilities , id , requirements

Constructor Summary	Page
BundleRevisionDTO ()	28

Methods inherited from class org.osgi.dto. DTO
toString

Field Detail

symbolicName

```
public String symbolicName

    The symbolic name of the bundle revision.
```

type

```
public int type
```

The type of the bundle revision.

version

```
public String version
```

The version of the bundle revision.

bundle

```
public long bundle
```

The id of the bundle associated with the bundle revision.

Constructor Detail

BundleRevisionDTO

```
public BundleRevisionDTO()
```

Class BundleWireDTO

[org.osgi.dto.framework.wiring](#)

```
java.lang.Object
├─ org.osgi.dto.DTO
│   └─ org.osgi.dto.resource.WireDTO
│       └─ org.osgi.dto.framework.wiring.BundleWireDTO
```

```
public class BundleWireDTO
extends WireDTO
```

Data Transfer Object for a BundleWire.

BundleWireDTOS are referenced [BundleWiringDTO.NodeDTOS](#).

NotThreadSafe

Field Summary		Page
int	providerWiring The identifier of the provider wiring for the bundle wire.	29
int	requirerWiring The identifier of the requiring wiring for the bundle wire.	29

Fields inherited from class <code>org.osgi.dto.resource.WireDTO</code>
capability , provider , requirement , requirer

Constructor Summary	Page
BundleWireDTO ()	30

Methods inherited from class <code>org.osgi.dto.DTO</code>
toString

Field Detail

providerWiring

```
public int providerWiring
```

The identifier of the provider wiring for the bundle wire.

See Also:
[WiringDTO.id](#)

requirerWiring

```
public int requirerWiring
```

The identifier of the requiring wiring for the bundle wire.

See Also:

[WiringDTO.id](#)

Constructor Detail

BundleWireDTO

```
public BundleWireDTO()
```

Class BundleWiringDTO

[org.osgi.dto.framework.wiring](#)

```
java.lang.Object
├── org.osgi.dto.DTO
│   └── org.osgi.dto.framework.wiring.BundleWiringDTO
```

```
public class BundleWiringDTO
extends DTO
```

Data Transfer Object for a BundleWiring graph.

An installed Bundle can be adapted to provide a `BundleWiringDTO` for the current wiring Bundle. `BundleWiringDTO` objects for all in use wirings of the Bundle can be obtained by adapting the bundle to `BundleWiringDTO[]`.

NotThreadSafe

Nested Class Summary		Page
static class	BundleWiringDTO.NodeDTO Data Transfer Object for a BundleWiring node.	33

Field Summary		Page
long	bundle The id of the bundle associated with the bundle wiring graph.	31
Set< BundleWiringDTO.NodeDTO >	nodes The set of wiring nodes referenced by the wiring graph.	32
Set< BundleRevisionDTO >	resources The set of resources referenced by the wiring graph.	32
int	root The identifier of the root wiring node of the bundle wiring graph.	31

Constructor Summary		Page
	BundleWiringDTO()	32

Methods inherited from class org.osgi.dto.DTO	
toString	

Field Detail

bundle

```
public long bundle
```

The id of the bundle associated with the bundle wiring graph.

root

```
public int root
```

The identifier of the root wiring node of the bundle wiring graph.

See Also:

[WiringDTO.id](#)

nodes

```
public Set<BundleWiringDTO.NodeDTO> nodes
```

The set of wiring nodes referenced by the wiring graph.

All wiring nodes referenced by wiring node identifiers in the wiring graph are contained in this set.

resources

```
public Set<BundleRevisionDTO> resources
```

The set of resources referenced by the wiring graph.

All resources referenced by resource identifiers in the wiring graph are contained in this set.

Constructor Detail

BundleWiringDTO

```
public BundleWiringDTO()
```


Class BundleWiringDTO.NodeDTO

[org.osgi.dto.framework.wiring](#)

```
java.lang.Object
├─ org.osgi.dto.DTO
│   └─ org.osgi.dto.resource.WiringDTO
│       └─ org.osgi.dto.framework.wiring.BundleWiringDTO.NodeDTO
```

Enclosing class:
[BundleWiringDTO](#)

```
public static class BundleWiringDTO.NodeDTO
extends WiringDTO
```

Data Transfer Object for a BundleWiring node.

The [providedWires](#) field must contain an array of [BundleWireDTOs](#). The [requiredWires](#) field must contain an array of [BundleWireDTOs](#).

NotThreadSafe

Field Summary		Page
boolean	current The current state of the bundle wiring.	33
boolean	inUse The bundle wiring's in use setting indicates that the bundle wiring is in use.	33

Fields inherited from class org.osgi.dto.resource.WiringDTO
capabilities , id , providedWires , requiredWires , requirements , resource

Constructor Summary	Page
BundleWiringDTO.NodeDTO ()	34

Methods inherited from class org.osgi.dto.DTO
toString

Field Detail

inUse

```
public boolean inUse
```

The bundle wiring's in use setting indicates that the bundle wiring is in use.

current

```
public boolean current
```

The current state of the bundle wiring. The bundle wiring's current setting indicates that the bundle wiring is the current bundle wiring for the bundle.

Constructor Detail

BundleWiringDTO.NodeDTO

```
public BundleWiringDTO.NodeDTO()
```

Package org.osgi.dto.resource

```
@org.osgi.annotation.versioning.Version(value="1.0")
```

OSGi Data Transfer Object Resource Package Version 1.0.

See:

[Description](#)

Class Summary		Page
CapabilityDTO	Data Transfer Object for a Capability.	36
CapabilityRefDTO	Data Transfer Object for a reference to a Capability.	38
RequirementDTO	Data Transfer Object for a Requirement.	40
RequirementRefDTO	Data Transfer Object for a reference to a Requirement.	42
ResourceDTO	Data Transfer Object for a Resource.	44
WireDTO	Data Transfer Object for a Wire.	46
WiringDTO	Data Transfer Object for a Wiring node.	48

Package org.osgi.dto.resource Description

OSGi Data Transfer Object Resource 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.dto.resource; version="[1.0,2.0)"
```

Example import for providers implementing the API in this package:

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

Class CapabilityDTO

[org.osgi.dto.resource](#)

```
java.lang.Object
├─ org.osgi.dto.DTO
│   └─ org.osgi.dto.resource.CapabilityDTO
```

```
public class CapabilityDTO
extends DTO
```

Data Transfer Object for a Capability.

NotThreadSafe

Field Summary		Pag e
Map<String, Object>	attributes The attributes for the capability.	37
Map<String, String>	directives The directives for the capability.	37
int	id The unique identifier of the capability.	36
String	namespace The namespace for the capability.	36
int	resource The identifier of the resource declaring the capability.	37

Constructor Summary	Pag e
CapabilityDTO ()	37

Methods inherited from class org.osgi.dto. DTO
toString

Field Detail

id

```
public int id
```

The unique identifier of the capability.

This identifier is transiently assigned and may vary across restarts.

namespace

```
public String namespace
```

The namespace for the capability.

directives

```
public Map<String,String> directives
```

The directives for the capability.

attributes

```
public Map<String,Object> attributes
```

The attributes for the capability.

The value type must be a numerical type, Boolean, String, DTO or an array of any of the former.

resource

```
public int resource
```

The identifier of the resource declaring the capability.

See Also:

[ResourceDTO.id](#)

Constructor Detail

CapabilityDTO

```
public CapabilityDTO()
```

Class CapabilityRefDTO

[org.osgi.dto.resource](#)

```
java.lang.Object
└─ org.osgi.dto.DTO
    └─ org.osgi.dto.resource.CapabilityRefDTO
```

```
public class CapabilityRefDTO
extends DTO
```

Data Transfer Object for a reference to a Capability.

NotThreadSafe

Field Summary		Page
int	capability The identifier of the capability in the resource.	38
int	resource The identifier of the resource declaring the capability.	38

Constructor Summary	Page
CapabilityRefDTO ()	39

Methods inherited from class org.osgi.dto. DTO
toString

Field Detail

capability

```
public int capability
```

The identifier of the capability in the resource.

See Also:
[CapabilityDTO.id](#)

resource

```
public int resource
```

The identifier of the resource declaring the capability.

See Also:
[ResourceDTO.id](#)

Constructor Detail

CapabilityRefDTO

```
public CapabilityRefDTO()
```

Class RequirementDTO

[org.osgi.dto.resource](#)

```
java.lang.Object
├── org.osgi.dto.DTO
│   └── org.osgi.dto.resource.RequirementDTO
```

```
public class RequirementDTO
    extends DTO
```

Data Transfer Object for a Requirement.

NotThreadSafe

Field Summary		Page
Map<String, Object>	attributes The attributes for the requirement.	41
Map<String, String>	directives The directives for the requirement.	41
int	id The unique identifier of the requirement.	40
String	namespace The namespace for the requirement.	40
int	resource The identifier of the resource declaring the requirement.	41

Constructor Summary	Page
RequirementDTO ()	41

Methods inherited from class <code>org.osgi.dto.DTO</code>
toString

Field Detail

id

```
public int id
```

The unique identifier of the requirement.

This identifier is transiently assigned and may vary across restarts.

namespace

```
public String namespace
```

The namespace for the requirement.

directives

```
public Map<String,String> directives
```

The directives for the requirement.

attributes

```
public Map<String,Object> attributes
```

The attributes for the requirement.

The value type must be a numerical type, Boolean, String, DTO or an array of any of the former.

resource

```
public int resource
```

The identifier of the resource declaring the requirement.

See Also:

[ResourceDTO.id](#)

Constructor Detail

RequirementDTO

```
public RequirementDTO()
```

Class RequirementRefDTO

[org.osgi.dto.resource](#)

```
java.lang.Object
├─ org.osgi.dto.DTO
│   └─ org.osgi.dto.resource.RequirementRefDTO
```

```
public class RequirementRefDTO
extends DTO
```

Data Transfer Object for a reference to a Requirement.

NotThreadSafe

Field Summary		Page
int	requirement The identifier of the requirement in the resource.	42
int	resource The identifier of the resource declaring the requirement.	42

Constructor Summary	Page
RequirementRefDTO()	43

Methods inherited from class org.osgi.dto. DTO
toString

Field Detail

requirement

```
public int requirement
```

The identifier of the requirement in the resource.

See Also:
[RequirementDTO.id](#)

resource

```
public int resource
```

The identifier of the resource declaring the requirement.

See Also:
[ResourceDTO.id](#)

Constructor Detail

RequirementRefDTO

```
public RequirementRefDTO()
```

Class ResourceDTO

[org.osgi.dto.resource](#)

```
java.lang.Object
├── org.osgi.dto.DTO
│   └── org.osgi.dto.resource.ResourceDTO
```

Direct Known Subclasses:

[BundleRevisionDTO](#)

```
public class ResourceDTO
    extends DTO
```

Data Transfer Object for a Resource.

NotThreadSafe

Field Summary		Page
List< CapabilityDTO >	capabilities The capabilities of the resource.	44
int	id The unique identifier of the resource.	44
List< RequirementDTO >	requirements The requirements of the resource.	45

Constructor Summary	Page
ResourceDTO ()	45

Methods inherited from class org.osgi.dto.DTO
toString

Field Detail

id

```
public int id
```

The unique identifier of the resource.

This identifier is transiently assigned and may vary across restarts.

capabilities

```
public List<CapabilityDTO> capabilities
```

The capabilities of the resource.

requirements

```
public List<RequirementDTO> requirements
```

The requirements of the resource.

Constructor Detail

ResourceDTO

```
public ResourceDTO()
```

Class WireDTO

[org.osgi.dto.resource](#)

```
java.lang.Object
├─ org.osgi.dto.DTO
│   └─ org.osgi.dto.resource.WireDTO
```

Direct Known Subclasses:
[BundleWireDTO](#)

```
public class WireDTO
extends DTO
```

Data Transfer Object for a Wire.

NotThreadSafe

Field Summary		Page
CapabilityRefDTO	capability Reference to the Capability for the wire.	46
int	provider The identifier of the provider resource for the wire.	47
RequirementRefDTO	requirement Reference to the Requirement for the wire.	46
int	requirer The identifier of the requiring resource for the wire.	47

Constructor Summary	Page
WireDTO()	47

Methods inherited from class org.osgi.dto. DTO
toString

Field Detail

capability

```
public CapabilityRefDTO capability
    Reference to the Capability for the wire.
```

requirement

```
public RequirementRefDTO requirement
    Reference to the Requirement for the wire.
```

provider

```
public int provider
```

The identifier of the provider resource for the wire.

See Also:

[ResourceDTO.id](#)

requirer

```
public int requirer
```

The identifier of the requiring resource for the wire.

See Also:

[ResourceDTO.id](#)

Constructor Detail

WireDTO

```
public WireDTO()
```

Class WiringDTO

[org.osgi.dto.resource](#)

```
java.lang.Object
├─ org.osgi.dto.DTO
│   └─ org.osgi.dto.resource.WiringDTO
```

Direct Known Subclasses:
[BundleWiringDTO.NodeDTO](#)

```
public class WiringDTO
extends DTO
```

Data Transfer Object for a Wiring node.

NotThreadSafe

Field Summary		Pag e
List< Capab ilityRefDT O >	capabilities The references to the capabilities for the wiring node.	48
int	id The unique identifier of the wiring node.	48
List< WireD TO >	providedWires The provided wires for the wiring node.	49
List< WireD TO >	requiredWires The required wires for the wiring node.	49
List< Requi rementRefD TO >	requirements The references to the requirements for the wiring node.	49
int	resource The identifier of the resource associated with the wiring node.	49

Constructor Summary	Pag e
WiringDTO ()	49

Methods inherited from class org.osgi.dto.DTO
toString

Field Detail

id

```
public int id
```

The unique identifier of the wiring node.

This identifier is transiently assigned and may vary across restarts.

capabilities

```
public List<CapabilityRefDTO> capabilities
```


The references to the capabilities for the wiring node.

requirements

```
public List<RequirementRefDTO> requirements
```

The references to the requirements for the wiring node.

providedWires

```
public List<WireDTO> providedWires
```

The provided wires for the wiring node.

requiredWires

```
public List<WireDTO> requiredWires
```

The required wires for the wiring node.

resource

```
public int resource
```

The identifier of the resource associated with the wiring node.

See Also:

[ResourceDTO.id](#)

Constructor Detail

WiringDTO

```
public WiringDTO()
```

Java API documentation generated with [DocFlex/Doclet](#) v1.5.6

DocFlex/Doclet is both a multi-format Javadoc doclet and a free edition of [DocFlex/Javadoc](#). If you need to customize your Javadoc without writing a full-blown doclet from scratch, DocFlex/Javadoc may be the only tool able to help you! Find out more at www.docflex.com

7 Considered Alternatives

7.1 Compendium DTOs

We decided that RFCs for a given specification should be the place for DTOs for that specification to be defined. The RFC template now has a DTO section. Therefore this RFC will only address the DTOs for the Core specification.

It was discussed how to obtain DTO instances from other services (e.g. ConfigAdmin). An "Adapter" concept was discussed but not agreed to. It was also discussed that the services add new "getDTO" methods. No conclusion was reached.

8 Security Considerations

Data transfer objects have limited behavior by definition. This behavior requires no permissions.

9 Document Support

9.1 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]. Data Transfer Object. https://en.wikipedia.org/wiki/Data_transfer_object

9.2 Author's Address

Name	BJ Hargrave
Company	IBM Corporation

Name	David Bosschaert
Company	Red Hat

9.3 Acronyms and Abbreviations

DTO – Data Transfer Object

9.4 End of Document