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# Oracle Storage Connect plug-in Development Guide

## **General**

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Revision 1.2.10-BETA

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## Executive Summary

The Oracle Storage Connect framework provides a storage discovery and provisioning Application Programming Interface (API) that is intended to greatly enhance the ease with which storage can be managed and provisioned in an Oracle VM environment. The combined solutions will allow customers to provision and manage participating storage platforms through Oracle VM Manager and Oracle Enterprise Manager, simplifying virtual infrastructure management, and delivering faster virtual machine configuration and control. Public and private cloud infrastructures using virtualized compute and storage services will also benefit from accelerated provisioning and simpler, integrated management.

## Structure of the documents

The development guide for the API is broken up into three different documents, namely the *General* (this document), [Storage Array](#) and the [File System](#) documents. The General document gives information regarding both types of plug-ins while the other two documents focuses on one specific type of plug-in as described in their respective titles.

***NOTE: As of rev 1.2.10-BETA the File System part is obsoleted and is only included as a reference, no vendor supplied File System plugin will be accepted / supported.***

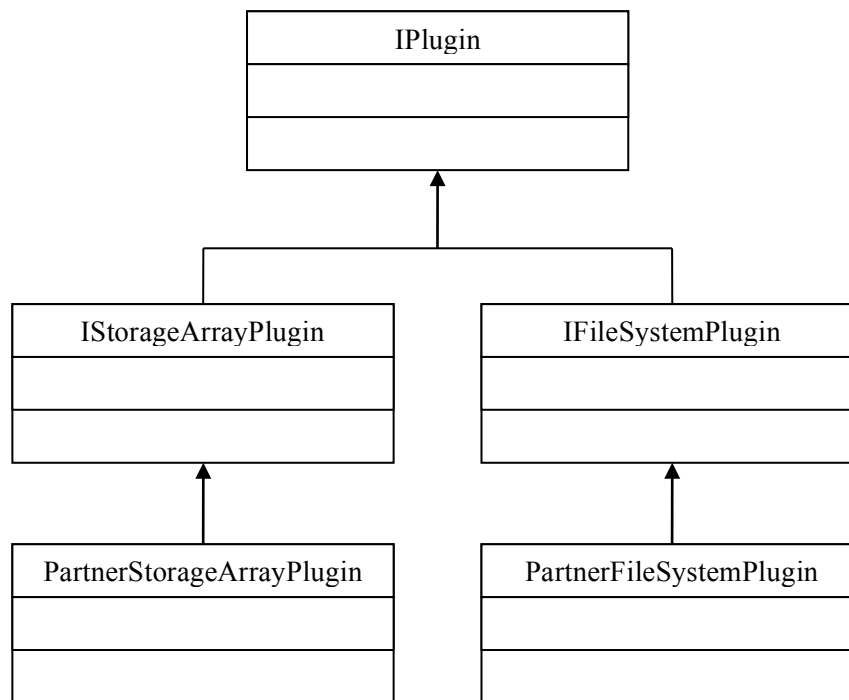
## The Storage Connect API

The Oracle Storage Connect API (hereafter just API) is Python based and as such, the top level of all the plug-ins must be implemented in Python. There is no requirement that the full plug-in be implemented in Python. It is completely supported to have the top level Python call out to a utility or library implemented in a different language to perform the action requested via the plug-in method.

The architecture of the API is explained in more detail in the next section but essentially it consists of three predefined classes, all plug-ins must inherit from either the `IStorageArrayPlugin` or `IFileSystemPlugin` class. Since a plug-in can be executed on any dom0 or utility server at any time, all plug-ins must be stateless, a plug-in can under no circumstance keep state between calls, to this effect all class methods in the API have been decorated as `@staticmethod` and the top level class explicitly denies instantiating any class inheriting from it.

## Architecture

The Storage Connect API consists of one base class and two specializing classes. A plug-in will inherit from one of the two specializing classes depending on the type of plug-in. The class diagram is shown below (for simplicity, all the attributes and methods are hidden):



## Implementation

Developing a plug-in consists of sub-classing either the `IStorageArrayPlugin` (iSCSI or SAN) or `IFileSystemPlugin` (NFS) classes. The term SAN, as far as a plug-in is concerned, refers to any type of SCSI block device protocol except iSCSI, for example it can refer to SAS, Fibre Channel, shared SCSI etc. The plug-in must implement all the methods marked as **REQUIRED**, see the [Storage Array](#) and/or the [File System](#) documents for more information. Plug-ins should not create any files on the server to store information also temporary files can be requested via the `IPlugin` class only. Please note that the plug-in executes as the `root` user on the server, so it is essential to make sure that the plug-in does not open any security holes.

## Packaging for deployment

All plug-ins are distributed as RPM packages (Appendix B contains a sample RPM `.spec` file that can be used for the plug-in with minimal changes). The top-level installation directory for the plug-in will be:

```
/opt/storage-connect/plugins/vendor/<plugin-module>
```

The plug-in should be packaged as a Python module, so it should include a `__init__.py` file at the plug-in module level. The `__init__.py` file must set the `osc_<type>_plugins` module variable(s) to the names of the plug-in classes, where `<type>` is either `ifs`, indicating the class implements either the File System API or `isa`, indicating the class implements the Storage Array API, for example:

```
osc_isa_plugins=["oracle.gensa.OracleGenSCSI.GenericSCSI"]
```

This allows a single plug-in module to contain multiple Storage Connect plug-ins classes to enable sharing of common modules etc. between plug-ins from the same vendor. Also, note that a single plug-in



module can contain both Storage Array plug-in classes and File System plug-in classes as shown in the example below:

```
osc_isa_plugins=["oracle.gensa.OracleGenSCSI.GenericSCSI",  
                "oracle.gensa.StorageServer.StorageServer"]  
osc_ifs_plugins=["oracle.gensa.OCFS2.OCFS2",  
                "oracle.gensa.NFS.GenericNFS"]
```

If the plug-in depends on Java or some other external technology that the plug-in can use the RPM dependency so the dependent, RPMs will be installed when the plug-in is installed as well. Oracle will evaluate all the dependencies on a case-by-case basis to make sure the dependencies would be able to be accommodated inside the Oracle VM Server environment. If the plug-in depends on technology that cannot be accommodated in an Oracle VM Server environment, the plug-in can use a split implementation where only a very few calls is required to be able to run on the Oracle VM Server directly. By enabling the `split_plugin` option in the RPM spec file, two RPMs would be generated, one for the actual plug-in that would be able to install anywhere as well as a Meta RPM named `osc-requirer-vendor-plugin`. The Meta plug-in would only be able to install on a system where all the dependencies can be met. Also as part of the split, the plug-in should call the utility function `checkRequired(...)` at the start of each API that requires access to the commands that is pulled in via the Meta RPM.

**NOTE: ALL the plug-ins within the plug-in module MUST have the SAME version and it MUST exactly match the RPM version in the `.spec` file.**

## Licensing

There is no requirement for the plug-in to be release under the Open Source (GPL) or any other specific license, to this end the Oracle Storage Connect infrastructure is dual licensed under the Open Source (GPL) and the Oracle Specification, Development and Distribution licenses to allow for both Open Source (GPL) and propriety licensed Storage Connect plug-ins.

## Support and Maintenance

If the plug-in were released under the Open Source (GPL) license, Oracle would be able to distribute (if Oracle so choose) and support the plug-in and feedback any changes (bug fixes) back to the vendor for inclusion in updates from the vendor. If Oracle support is unable to resolve the problem Oracle support will contact the plug-in vendor to assist in supporting the plug-in. Closed Source (non GPL) plug-in support will follow the normal Oracle Support flow as used today and the plug-in must be made available to customers by the vendor. The vendor, no matter what license the plug-in is released under, will maintain the plug-in code supplied by the vendor.

## Terminology

Throughout this document and specification, we will be referring to these terms. It is extremely important to use consistent and clear terminology throughout all the plug-in implementations, which is why we define these up front. We understand that these may not match the terminology used by each partner. It should be easy to map these to whatever terms are in use for the specific storage device. It is not necessary to use these terms when talking to customers etc., they are just used internally by the product and the plug-in

Storage Array	Any block based storage device, be it Fibre Channel (SAN), Ethernet (iSCSI), or direct connect (SCSI/SAS/DAS) based.
Storage Element	This term refers to any type of storage that the Storage Array support, for example: LUNs, Snapshots, Clones etc.
NAS	Any network file system based storage (NFS).

Storage Server	Refer to either a Storage Array or NAS depending on the type of plug-in.
Snapshot	Frozen thin provisioned <b>read only</b> point in time copy of a LUN (or file). This implies that a Snapshot remains a child of the original LUN (or file).
Clone	Thin provisioned <b>read write</b> copy of a LUN (or file). There is an implication that the possibility exist to determine from which LUN this is a <i>clone</i> .
Snap Clone	Thin provisioned <b>read write</b> copy of a previously created <i>Snapshot</i> . This implies that the parent child relationship for the Snapshot stays intact.
Split Clone	This refers to a deep copy of a previously created <i>clone</i> . This implies that the LUN is now a top level object and have no parents (it can become a parent when a Snapshot operation is triggered though)
Volume Group	LUNs, file systems etc. are carved from this <i>optional</i> grouping construct.
Access Group	Access groups are used to limit the server that can interact ('see') a specific LUN or mount a file system. For LUNS this would normally be a list of iSCSI initiators and for Fibre Channel a list of HBA port WWNs. For NFS this is normally the list of hosts the file system is exported to.

## Some best practices for developing the plug-in

Even though there is no hard and fast rules on developing a Storage Connect plug-in there are still some guidelines to keep in mind when developing the plug-in.

- Use of temporary files  
The plug-in should use as few as possible temporary files. It is preferable if the plug-in does not use any temporary files. In "[Appendix A](#)" a few examples are listed in ways to still call out to other tools etc. without requiring temporary files. If a temporary file is required (maybe if an external tool require a file for output), the temporary file must be obtained via the `IPlugin` class, please see "[Using a temporary file in a plug-in](#)".
- Calling an external script  
It is preferable to implement what the external script does directly inside the Python plug-in classes if possible. Calling out to a script that essentially just calls an executable and run *sed* on its output or something similar, should be avoided. This is not intended to indicate that the plug-in are not allowed calling out to a script. The point here is just when calling out to a script; the script should add real value and not just be a wrapper script for another executable.
- Python indentation  
Python is very sensitive to indentation. For this reason, we strongly suggest to **only** use spaces for indentation and not tab characters.

## Logging

The plug-in is expected to log any problems using the standard Python logging facility. The plug-ins is supplied with a logging class which they can reference using the `IPlugin.logger` class variable. This is a preconfigured `logging.getLogger` instance. Plug-ins should NOT change any of the logging options for the instance (they are pre-configured) and should never print anything to standard output or try to read anything from standard input.

## Caching

The plug-in can (and is strongly suggested) to cache the raw data from the Storage Server. In general the connection and authentication to the Storage Server is slow and very heavy. The idea is to obtain as much information as possible in a single connection and store all of it in the cache. On subsequent calls, the information can most likely be satisfied using the cache. The caching mechanism is implemented using two plugin manager calls, `IPlugin.cache.set()` and `IPlugin.cache.get()`.

## `IPlugin.cache.set()`

Parameters:

Name	Type	Optional	Description
ss_uuid	UUID	No	The UUID of the Storage Server this specific key is associated with.
cache_key	String	No	Name (key) of cache. This can be any valid string value.
cache_value	String	No	This is the data to be cached. The value must be a string but it is completely valid to use <code>cPickle.dumps()</code> (ONLY protocol 0 are allowed to be used when pickling up the data) and <code>cPickle.loads()</code> to serialize/de-serialize Python objects.
expire_time	Integer	Yes	Expire time in seconds for this particular cache entry. If not supplied, the default (30 seconds) will be used.

Return value:

N/A.

Use this method to store any data that might be useful in the future to speed up any subsequent plugin calls. To clear the cache for this specific key just set the `cache_value` to `None`.

### IPlugin.cache.get()

Parameters:

Name	Type	Optional	Description
ss_uuid	UUID	No	The UUID of the Storage Server this specific key is associated with.
cache_key	String	No	Name (key) of cached value being queried.

Return value:

String containing the previously stored cache data or `None` if the cache expired or does not exist.

This method is used to retrieve the previously cached data. If the cached data already expired or does not exist, it returns `None`.

### IPlugin.cache.extend()

Parameters:

Name	Type	Optional	Description
ss_uuid	UUID	No	The UUID of the Storage Server this specific key is associated with.
cache_key	String	No	Name (key) of the cached value being extended.
extend_time	Integer	No	Time in seconds to extend the cached value's expire time.

Return value:

N/A.

If for some reason the plugin would like to make available longer, it can use this call to add time (in seconds) to the expiration timer for the cache.

### IPlugin.cache.clear()

Parameters:

Name	Type	Optional	Description
------	------	----------	-------------

ss_uuid	UUID	No	The UUID of the Storage Server being removed from the cache.
---------	------	----	--

Return value:  
N/A.

This will clear ALL the cache key and values associated with the Storage Server supplied.

## Exceptions

Methods do not have failure returns. All error conditions have to be signaled via raising an exception.

There are a number of exceptions classes pre-defined, plug-ins are not allowed to define more, if there is a need for a specific class that is not pre-defined, please let us know and so we can consider adding it to the official specification. Below is the list of currently defined exception classes (Note: the plug-in should never raise the `IPluginException` class directly).

### IPluginException

This is the base class for all the other `IPlugin` exception classes.

### NoSuchOperationEx

If the plug-in or the Storage Server does not support the specific operation, the plug-in should raise this exception.

### OperationFailedEx

This is the exception of last resort, if no other exception class fit the specific error situation the plug-in is trying to convey, this exception can be raised using a descriptive message.

### MissingKeyEx

If the plug-in encounter a situation where it expect a certain key to be present in one for the records passed in and it is not, it should raise this exception. Note this exception takes both a message and the key name that is missing.

### ValueFormatEx

If a value for a key in one of the records is invalid (this is not the same as the key being missing), the plug-in should raise this exception. Note this exception also takes a message as well as the name of the key of which the data is invalid.

### StorageArrayLicenseEx

If the plug-in is being requested to invoke a licensed feature on the Storage Server and the license is not installed on the Storage Server, the plug-in should raise this exception. For example if the plug-in is requested to validate a new Storage Server record with the storage type being set to iSCSI but iSCSI is not licensed on the Storage Server, the plug-in would raise the exception with the message indicating that the Storage Server is not licensed for iSCSI access.

### TargetDiscoveryEx

For an iSCSI Storage Server, if the target discovery fails, the plug-in should raise this exception with the error encountered discovering the targets.

### LoginFailedEx

For an iSCSI Storage Server, if the logging into the targets fail, the plug-in should raise this exception with the error encountered trying to login to the targets.

### **LogoutFailedEx**

For an iSCSI Storage Server, if the logging out of the targets fails, the plug-in should raise this exception with the error encountered trying to logout of the targets.

### **RefreshFailedEx**

If the plug-in is unable to refresh the SCSI bus for the specific Storage Server, the plug-in should raise this exception with the message indicating what the error the plug-in encountered.

### **ListFailedEx**

If the plug-in run into errors trying to list (using the `list` method) or update the Storage Element records (using the `updateSERecords` method), the plug-in should raise this exception.

### **CreateSnapFailedEx**

If the plug-in is unable to create a snapshot for the Storage Element, the plug-in should raise this exception with the message indicating the specific problem.

### **ListSnapFailedEx**

This exception is intended to be raised by the plug-in is unable to retrieve a list of the existing snapshots on the Storage Server.

### **SnapRestoreNotSafeEx**

When the plug-in is requested to roll back a snapshot for a Storage Element and it cannot be safely done without affecting other Storage Elements etc., the plug-in must raise this exception and not attempt rolling back the snapshot.

### **CloneFailedEx**

If the plug-in encounter an error when requested to create a clone (either via the `clone` or `cloneFromSnap` methods), the plug-in should raise this exception.

### **InvalidStorageArrayEx**

The Storage Server record specified failed validation. This exception is only allowed to be raised by the `validate` method.

### **InvalidValueEx**

If the plug-in detect an invalid value in any for the records (including the `extra_info` fields), the plug-in should raise this exception.

### **StorageElementBusyEx**

If the Storage Server does not support the operation being performed while the Storage Element is online or mapped, the plug-in should raise this exception.

### **PermissionDeniedEx**

If the plug-in is not authorized to perform the specific action requested, it should raise this exception with the message indicating the exact permission error returned by the Storage Server.

### **OperationPreReqNotMetEx**

The plug-in raise this exception if a pre-requisite is not met for the requested operation.

### StorageNameRequiredEx

This exception can only be raised in the `validate` call by the plug-in if the plug-in requires the `storage_name` to be set in the Storage Server record.

### InvalidFSTypeEx

The File System type is not valid for the particular plug-in. This exception is only allowed to be raised by the `validate` method.

### FileSystemBusyEx

If the Storage Server does not support the operation being performed while the File System is online or mounted, the plug-in should raise this exception.

### FileSystemAlreadyMountedEx

If the File System is already mounted, the plug-in should raise this exception on any subsequent mount requests.

## Enum definitions

The API defines a pre-defined enumeration type that are used by the `ability dict` to indicate what specific operations the plug-in and the Storage Server can support.

### ABILITY\_TYPES enumeration

The `ABILITY_TYPES` enumeration contains the following identifiers:

Identifier	Description
UNSUPPORTED	If the plug-in (or the Storage Server) do not support a particular feature the value for the ability key should be set to this.
OFFLINE	If the plug-in (or the Storage Server) can only perform the specific operation while the target (or source) storage entity needs to be offline.
ONLINE	If the plug-in (or the Storage Server) can be performed while the storage entity is online and being actively used.
NO	If the plug-in (or the Storage Server) does not have a particular feature the value for the ability key should be set to this. NOTE: Only certain keys allow for YES and NO values, they are highlighted in the <code>ability dict</code> in the respective documents.
YES	If the plug-in (or the Storage Server) does have a particular feature the value for the ability key should be set to this. NOTE: Only certain keys allow for YES and NO values, they are highlighted in the <code>ability dict</code> in the respective documents.
INVALID	This value should never be used by a plug-in; it is just a placeholder value.

### BACKING\_DEVICE\_TYPES enumeration

The `BACKING_DEVICE_TYPES` enumeration contains the following identifiers:

Identifier	Description
UNSUPPORTED	This is to indicate that the plugin cannot create a file system.
DEVICE_SINGLE	The File System can only exist / be created on a single block device.
DEVICE_MULTI	The File System can exist / be created on a many block devices.
PLUGIN_SINGLE	The File System is not block based and can only exist / be created on a single backing device. The list of available backing devices will be obtained via the <a href="#">getFileSystemBackingDevices()</a> call.

PLUGIN_MULTI	The File System is not block based and can exist / be created on a multiple backing devices. The list of available backing devices will be obtained via the <a href="#">getFileSystemBackingDevices()</a> call.
INVALID	This value should never be used by a plug-in; it is just a placeholder value.

## SE\_STATES enumeration

The SE\_STATES enumeration contains the following identifiers:

Identifier	Description
UNKNOWN	The Storage Element is in an Unknown state; this effectively indicates an error condition and the Storage Element would be marked as such.
OFFLINE	The Storage Element is in an Offline state and cannot be accessed for normal I/O operations.
BUSY_CREATE	The Storage Element is still being created and is not available for any operations yet.
BUSY_CLONE	The Storage Element is still being cloned, this state is only applicable to the destination of a clone operation.
BUSY_COPY	The Storage Element is still being deep copied (being split from its peer or parent).
BUSY_CHILDREN	The Storage Element is locked busy since it have active children (i.e. it cannot be delete before all the children are either split or released from the parent).
ERROR	The Storage Element is in an error condition and cannot be used or operated on.
ONLINE	The Storage Element is an Online state. This is the <b>normal</b> operating state.

## FS\_STATES enumeration

The FS\_STATES enumeration contains the following identifiers:

Identifier	Description
UNKNOWN	The File System is in an Unknown state; this effectively indicates an error condition and the File System would be marked as such.
UNMOUNTED	The File System is available but not mounted.
MOUNTED	The File System is currently mounted. This is the <b>normal</b> operating state.
MOUNTED_READONLY	The File System is currently mounted in READ ONLY mode.
ERROR	The File System is in an error condition and cannot be used or operated on.

## Record definitions

The API makes use of a few predefined records (they are implemented using Python dict objects), namely the Storage Server record (`ss_record`), the Storage Element record (`se_record`), the File System record (`fs_record`), and the File record (`file_record`). Note that both the `IStorageArrayPlugin` and `IFileSystemPlugin` plug-ins use the Storage Server record.

## Storage Server Record

The `ss_record` is used by both `IStorageArrayPlugin` and `IFileSystemPlugin` plug-ins and have the following known fields:

Attribute name	Type	Allow Update	Description	Optional
name	String	Only if Empty	User-friendly name of the Storage Server as shown in the Oracle VM Manager. This will be supplied by the user when creating the Storage Server object.	No
uuid	UUID	Only if Empty	UUID generated by the Oracle VM Manager when the new Storage Server object is created.	No

storage_server_id	String	Yes	Opaque Storage Server unique identifier. This is for use solely by the plug-in to uniquely identify the Storage Server.	Yes
storage_type	String	No	For a Storage Server plug-in it will be set to either <code>IStorageArrayPlugin.SANStorage</code> or <code>IStorageArrayPlugin.iSCSIStorage</code> . For a File System plug-in it will be set to either <code>IFileSystemPlugin.NetworkFileSystem</code> or <code>IFileSystemPlugin.BlockBasedFileSystem</code> .	No
chap	Bool	No	This will be set if the Storage Server requires CHAP authentication.	Yes
admin_host	String	No	Hostname / IP address used to administrate the Storage Server.	No
admin_user	String	No	Administrator username.	No
admin_passwd	String	No	Administrator password.	No
netdevs	List	No	Network device(s) that should be used when accessing the Storage Server. This is used in conjunction with the <a href="#">access_host</a> . This is to enable forcing iSCSI I/O traffic over a specific network device.	Yes
status	String	Yes	Current status of the Storage Server.	No
total_sz	Integer	Yes	Total size of the Storage Server (in bytes). (If the Storage Server does not support this, return this as -1 which would translate to 'Not Applicable')	Yes
used_sz	Integer	Yes	Actual space already used on the Storage Server (in bytes). (If the Storage Server does not support this, return this as -1 which would translate to 'Not Applicable')	Yes
free_sz	Integer	Yes	Available space on the Storage Server (in bytes). (If the Storage Server does not support this, return this as -1 which would translate to 'Not Applicable')	Yes
alloc_sz	Integer	Yes	Size of already allocated space on the Storage Server (in bytes). The difference between this and the <code>used_space</code> key is that <code>used_space</code> does not include any reserved space, for example, if the Storage Server supports sparse allocation and/or de-duplication used space would only return the actual space used and this key would return space that will be consumed when the sparse holes are filled in. (If the Storage Server does not support this, return this as -1 which would translate to 'Not Applicable')	Yes
access_grps	List	No	List of <a href="#">access_grp</a> dicts for the Storage Server.	No
vol_groups	List	Yes	List of <a href="#">vol_group</a> dicts known by the Storage Server. This list (if any) is displayed to the user to allow selecting one when a new Storage Element is created.	Yes



storage_name	String	No	Actual name of the Storage Server controller as entered or selected by the user when creating the Storage Server. This will uniquely identify the correct controller to operate on if the Storage Server manager supports multiple controllers at the same time.	Yes
storage_id	List	Yes	Storage Server identifier strings (for instance the target names for iSCSI). The content of this attribute is opaque to the Oracle VM Manager.	Yes
storage_desc	String	Yes	Storage Server description.	No
extra_info	String	No	Open form opaque information that passed to/from the plug-in for use internally by the plug-in. The Oracle VM product does not look or try to interpret any of the information in this field.	Yes
access_descriptors	List	No	List of <a href="#">access_descriptor</a> dicts for the iSCSI Storage Array.  If present, the access_host, access_port, username and passwd attributes will not be present. See “access_descriptor dict definition” for more information.	Yes
access_host	String	No	If the Storage Server is network based the user will enter the hostname or IP address used to access the storage.	Yes
access_port	Integer	Only if Empty	If the Storage Server is network based, this may optionally contain the port number to be used when accessing the storage.	Yes
username	String	No	Username to use when logging into the storage server.	Yes
passwd	String	No	Password to use when logging into the storage server.	Yes
iscsi_storage_targets	List	No	List of <a href="#">iscsi_storage_target</a> dicts (used with the iSCSI Storage Server only.)	Yes

### access\_descriptor dict definition

The `access_descriptor` dict is defined as follows:

Attribute name	Type	Allow Update	Description	Optional
access_host	String	No	The user will enter the hostname or IP address used to access the iSCSI storage.	Yes
access_port	Integer	Only if Empty	This may optionally contain the port number to be used when accessing the storage.	Yes
username	String	No	Username to use when logging into the iSCSI Storage Array.	Yes
passwd	String	No	Password to use when logging into the iSCSI Storage Array.	Yes

The `ss_record` that the OVM Manager passes to the storage plug-in includes an ***access context***. This access context takes one of two forms that are mutually exclusive of each other.

## Form 1 – (original form)

For all iSCSI plug-ins that have not been modified to support 1.2.9, and for all non-iSCSI plug-ins, the sole access context that the OVM Manager places into the `ss_record` consists of the discrete `access_host`, `access_port`, `username` and `passwd` attributes. The `ss_record` would not include the `access_descriptors` attribute.

## Form 2 – (introduced in 1.2.9 for iSCSI only)

If both the plug-in and the OVM Manager support multiple access hosts of an iSCSI Storage Array, the OVM Manager places the `access_descriptors` attribute into the `ss_record`. The discrete `access_host`, `access_port`, `username` and `passwd` attributes are absent from the `ss_record`.

An iSCSI plug-in must advertise its ability to receive Form 2 before the OVM Manager will send it. However, that plug-in should also be prepared to receive Form 1 in case that `ss_record` comes from an older version of the OVM Manager. An iSCSI storage plug-in advertises its ability to receive Form 2 by defining a class variable called `extended_api_version`, with a value of the list of strings `['1','2','9']`. See the “Oracle Storage Connect Development Guide – Storage Array” for more information regarding this class variable.

Compatibility between the OVM Manager and an iSCSI plug-in can be provided as follows.

### Case 1) Manager (3.0.3 & 3.1.1), iSCSI plug-in (pre-1.2.9)

- Neither the plug-in nor the Manager knows about Form 2. The Manager will place only Form 1 in the `ss_record`.

### Case 2) Manager (3.0.3 & 3.1.1), iSCSI plug-in (1.2.9 and later)

- The Manager can only supply Form 1 in the `ss_record`.
- Upon receipt of the `ss_record`, the plug-in first looks for the `access_descriptors` attribute. It will not be able to find it. The plug-in falls back to looking for the Form 1 attributes.

### Case 3) Manager (3.2.1 and later), iSCSI plug-in (pre-1.2.9)

- The Manager looks for, but does not receive, the `extended_api_version` class variable from the plug-in. This plug-in does not implement that variable. The Manager concludes that the plug-in cannot receive a Form 2 access context.
- The Manager provides the Form 1 access context in the `ss_record`.
- Upon receipt of the `ss_record`, the plug-in will only look for Form 1.

### Case 4) Manager (3.2.1 and later), iSCSI plug-in (1.2.9 and later)

- The Manager looks for and receives the `extended_api_version` class variable from the plug-in and verifies that its value is `['1','2','9']` or higher. The Manager concludes that this plug-in recognizes Form 2 access contexts. The Manager provides only Form 2 in the `ss_record`.
- Upon receipt of the `ss_record`, the plug-in looks for the `access_descriptors` attribute and finds it. The plug-in should not look for the non-existent Form 1 attributes in the `ss_record`.

### access\_grp dict definition

The `access_grp dict` is defined as follows:

Attribute name	Type	Allow Update	Description	Optional
<code>grp_name</code>	String	Yes	This is the name of the access group as defined on the Storage Server. If the Storage Server do not support named access groups the plug-in can ignore the name, if the plug-in have set correct flags in the plug-in ability.	No
<code>grp_entries</code>	List	Yes	This is the list of access entries for the access group. For example, for Fibre Channel this would be a list WWNs (using the 0x0000000000000000 format for the port name, lower-cased), for iSCSI a list of initiators and for file systems, this would be a list of the host names.	No
<code>grp_modes</code>	List	Yes	An optional list of modes that are associated with the access group, for example in the case of a NFS file system it can contain the export options for the file system export.	Yes

### iscsi\_storage\_target dict definition

The `iscsi_storage_target dict` is defined as follows:

Attribute name	Type	Allow Update	Description	Optional
<code>iscsi_portal_address</code>	String	No	Portal IP address through which (together with <code>iscsi_portal_port</code> ) this iSCSI storage target was discovered, and through which the discovering server may subsequently log in.	No
<code>iscsi_portal_port</code>	Integer	No	The port associated with <code>iscsi_portal_address</code> when discovering and logging into this iSCSI storage target.	No
<code>iscsi_target_name</code>	String	No	Target name for this iSCSI storage target. Example: "iqn.2001-05.com.myarray:0-8a0906-e15a77001-b6966439b6e518be-mydisk"	No

### vol\_group dict definition

The `vol_group dict` is defined as follows:

Attribute name	Type	Allow Update	Description	Optional
<code>vol_name</code>	String	Yes	This is the name of the volume group as defined on the Storage Server.	No
<code>vol_total_sz</code>	Integer	Yes	The volume group's total size (in bytes).	No
<code>vol_used_sz</code>	Integer	Yes	Actual space already used in the volume group (in bytes).	No
<code>vol_free_sz</code>	Integer	Yes	Amount of free space available in the volume group (in bytes).	No

vol_alloc_sz	Integer	Yes	Space already allocated in the volume group (in bytes). The difference between this and the used_space key is that used_space does not include any reserved space, for example, if the Storage Server supports sparse allocation and/or de-duplication used space would only return the actual space used and this key would return space that will be consumed when the sparse holes are filled in.	Yes
vol_desc	String	Yes	Description for the volume group, for example "RAID 5". Note: It is up to the plug-in to decide what to fill in here, there is no requirement as to what the field should contain, just something that the user would find useful when selecting which volume group to use when creating a new Storage Element.	Yes

### qos\_vals dict definition

The qos\_vals dict is defined as follows:

Attribute name	Type	Allow Update	Description	Optional
priority	Integer	Yes	This is priority of the QoS value, zero (0) being the highest priority. It is not required for the values to follow numerically.	No
value	String	Yes	This is the Quality-of-Service name as known by the Storage Server.	No
description	String	Yes	This is the description of this specific Quality-of-Service.	Yes

### Storage Element Record

The se\_record is only used by IStorageArrayPlugin plug-ins and have the following known fields:

Attribute name	Type	Allow Update	Description	Optional
se_type	String	Yes	This is required to be always set. This can currently be one of the following values: IStorageArrayPlugin.LUNType, IStorageArrayPlugin.GhostLUNType, IStorageArrayPlugin.SnapType, IStorageArrayPlugin.SnapCloneType.	No
ss_uuid	UUID	Only if Empty	This is the <a href="#">Storage Server record's UUID</a> . This allows for the persisting the association between any given Storage Element record to the owning Storage Server record.	No
name	String	Only if Empty	User-friendly name for the Storage Element as shown in Manager. This can be overwritten by the user in the Oracle VM Manager but the plug-in have to set this to something reasonable.	No
uuid	UUID	Yes	The UUID for the LUN (if the storage server supports UUIDs on a LUN basis).	No

page83_id	String	Yes	This should be set to the SCSI page 83 unique ID. If possible, the plug-in should return this, it is sometimes impossible to determine this for an un-presented LUN, in which case this key can be omitted from the return list.	No
id	String	Yes	Identifier for use internally by the plug-in, for instance the Snap ID or LUN ID.	Yes
vendor	String	Yes	The vendor string as reported by the SCSI INQ command.	Yes
product_id	String	Yes	The product string as reported by the SCSI INQ command.	Yes
path	List	Yes	This is a list of the system device paths for the LUN.	Depends
array_path	String	Yes	Path for the Storage Element on the Storage Server for use internally by the plug-in.	Yes
size	Integer	Yes	Size in bytes, of the Storage Element, normally returned but supplied for resizing operations.	No
status	String	Yes	Status of the Storage Element.	No
vol_group_name	String	Yes	The volume group name (if any) the Storage Element is part of on the Storage Server.	Yes
access_grp_names	List	Yes	List of access group names this Storage Element should be, or is presented to.	No
qos	String	Yes	The Quality-of-Service value for the Storage Element. NOTE: This is might not reflect the QoS of the Storage Element at all times since this can be set directly on the Storage Server.	Yes
state	<a href="#">SE_STATES_enum</a>	Yes	This is the current state of the Storage Element (see <a href="#">SE_STATES_enum</a> ).	No
async_handle	String	Yes	Temporary field that can be set for use by the <code>getAsyncProgress()</code> call. Although the value must be a string, it is completely valid to use <code>cPickle.dumps()</code> and <code>cPickle.loads()</code> to serialize/de-serialize Python objects and store them in the string. The plugin should store any data that will be required later by the <code>getAsyncProgress()</code> call to locate the previously started asynchronous operation on the Storage Server. This handle will <b>not</b> be persisted! It is for transient use while the asynchronous operation is active to retrieve status and progress on the asynchronous operation only!	Yes

async_progress	Integer	Yes	Temporary field that should be set by the <code>getAsyncProgress()</code> call only. Valid values are -1, 0 to 100 and <code>None</code> . A -1 value indicates the operation is still in progress but plugin is unable to determine the percentage complete. A value between 0 and 100 indicates the percentage complete for the operation. A <code>None</code> value indicates that the operation is completed. The <code>async_progress</code> value will <b>not</b> be persisted! It is for transient use while the asynchronous operation is active to communicate the progress of the asynchronous operation only!	Yes
extra_info	String	No	Open form opaque information that passed to/from the plug-in for use internally by the plug-in. The Oracle VM product does not look or try to interpret any of the information in this field.	Yes

## File System Record

The `fs_record` is only used by `IFileSystemPlugin` plug-ins and have the following known fields:

Attribute name	Type	Allow Update	Description	Optional
<code>access_path</code>	String	Yes	Access path for the file system, only used by networked file systems for example <code>myserver1:/my/export</code> .	Yes
<code>ss_uuid</code>	UUID	Only if Empty	This is the <a href="#">Storage Server record's UUID</a> . This allows for the persisting the association between any given File System record to the owning Storage Server record.	No
<code>name</code>	String	Only if Empty	User-friendly name for the file system as shown in the Oracle VM Manager. The plug-in should set this to something reasonable if empty.	No
<code>mount_options</code>	List	Yes	Default options that would be used when mounting a file system.	No
<code>export_opts</code>	List	Yes	Options the file system is being exported with on the Storage Server (for example <code>no_root_squash</code> etc.).	No
<code>array_path</code>	String	Yes	Path on the file system on the storage server. For use internally by the plug-in.	Yes
<code>uuid</code>	UUID	Yes	The UUID of the file system.	No
<code>size</code>	Integer	Yes	Size of the file system, normally returned but will be supplied for resizing operations.	No
<code>free_sz</code>	Integer	Yes	Free or available size on the file system.	No
<code>status</code>	String	Yes	Status of the file system.	No
<code>state</code>	<a href="#">FS STATES enum</a>	Yes	This is the current state of the File System (see <a href="#">FS_STATES enum</a> ).	No
<code>access_grp_names</code>	List	Yes	List of access group names the file system should be, or is exported (presented) to.	Yes
<code>qos</code>	String	Yes	The Quality-of-Service value for the File System. NOTE: This might not reflect the QoS of the File System at all times since this can be set directly on the Storage Server.	Yes
<code>backing_device</code>	String / List	No	Depending on the <code>backing_device_type</code> ability for the plugin and Storage Server, this would contain a single device (e.g. <code>/dev/sdc</code> ), a list of devices (e.g. <code>/dev/sdc, /dev/sdd</code> ) or the “value” key of the <a href="#">backing device</a> record.	Yes

async_handle	String	Yes	Temporary field that can be set for use by the <code>getAsyncProgress()</code> call. Although the value must be a string, it is completely valid to use <code>cPickle.dumps()</code> and <code>cPickle.loads()</code> to serialize/de-serialize Python objects and store them in the string. The plugin should store any data that will be required later by the <code>getAsyncProgress()</code> call to locate the previously started asynchronous operation on the Storage Server. This handle will <b>not</b> be persisted! It is for transient use while the asynchronous operation is active to retrieve status and progress on the asynchronous operation only!	Yes
async_progress	Integer	Yes	Temporary field that should be set by the <code>getAsyncProgress()</code> call only. Valid values are -1, 0 to 100 and None. A -1 value indicates the operation is still in progress but plugin is unable to determine the percentage complete. A value between 0 and 100 indicates the percentage complete for the operation. A None value indicates that the operation is completed. The <code>async_progress</code> value will <b>not</b> be persisted! It is for transient use while the asynchronous operation is active to communicate the progress of the asynchronous operation only!	Yes
extra_info	String	No	Open form opaque information that passed to/from the plug-in for use internally by the plug-in. The Oracle VM product does not look or try to interpret any of the information in this field.	Yes

## File Record

The `file_record` is only used by `IFileSystemPlugin` plug-ins and have the following known fields:

Attribute name	Type	Allow Update	Description	Optional
fr_type	String	Yes	This is required to be always set. This can currently be one of the following values: <code>IFileSystemPlugin.FileType</code> , <code>IFileSystemPlugin.DirType</code> , <code>IFileSystemPlugin.SymLinkType</code> , <code>IFileSystemPlugin.CharDevType</code> , <code>IFileSystemPlugin.BlkDevType</code> , <code>IFileSystemPlugin.FifoType</code> , <code>IFileSystemPlugin.SockFileType</code> , <code>IFileSystemPlugin.SnapType</code> , and <code>IFileSystemPlugin.SnapCloneType</code> .	No
file_path	String	Yes	Path to the file or snapshot to operate on (this can be a relative path under the file system mount path).	No
ondisk_sz	Integer	Yes	Size in bytes the file is physically using on disk (i.e. if the file is sparse this size would exclude all the non-allocated holes in the file).	Yes



file_sz	Integer	Yes	Size in bytes of the file (i.e. if the file is sparse this size would include all the non allocated holes in the file, in other words this is the apparent size of the file and not the physical use size).	No
fs_uuid	UUID	Only if Empty	This is the <a href="#">File System record UUID</a> . This allows for the persisting the association between any given File record to the owning File System record.	No
name_pattern	String	Yes	When doing listing files in the file system, this would optionally contain the regular expression to use for filtering out all unwanted files from the listing.	Yes
shared_sz	Integer	Yes	This is the amount of bytes the file is currently sharing with another file.	Yes
snap_name	String	Yes	Name of the snapshot.	Yes
dest_path	String	Yes	Destination path of a symbolic link (this can be a relative path under the file system mount path).	Yes
async_handle	String	Yes	Temporary field that can be set for use by the <code>getAsyncProgress()</code> call. Although the value must be a string, it is completely valid to use <code>cPickle.dumps()</code> and <code>cPickle.loads()</code> to serialize/de-serialize Python objects and store them in the string. The plugin should store any data that will be required later by the <code>getAsyncProgress()</code> call to locate the previously started asynchronous operation on the Storage Server. This handle will <b>not</b> be persisted! It is for transient use while the asynchronous operation is active to retrieve status and progress on the asynchronous operation only!	Yes
async_progress	Integer	Yes	Temporary field that should be set by the <code>getAsyncProgress()</code> call only. Valid values are -1, 0 to 100 and None. A -1 value indicates the operation is still in progress but plugin is unable to determine the percentage complete. A value between 0 and 100 indicates the percentage complete for the operation. A None value indicates that the operation is completed. The <code>async_progress</code> value will <b>not</b> be persisted! It is for transient use while the asynchronous operation is active to communicate the progress of the asynchronous operation only!	Yes
extra_info	String	No	Open form opaque information that passed to/from the plug-in for use internally by the plug-in. The Oracle VM product does not look or try to interpret any of the information in this field.	Yes

## Mount Record

The `mount_record` is only used by `IFileSystemPlugin` plug-ins and have the following known fields:

Attribute name	Type	Allow Update	Description	Optional
<code>uuid</code>	UUID	Only if Empty	This is the mount point record UUID. This allows for the unique identifying a specific mount point on different servers.	No
<code>fs_uuid</code>	UUID	Only if Empty	This is the <a href="#">File System record UUID</a> . This allows for persisting the association between the Mount record and the owning File System record.	No
<code>mount_point</code>	String	Yes	The absolute path name where the file system is mounted.	No
<code>options</code>	List	Yes	The actual mount options in use on this particular mount point.	
<code>share_path</code>	String	Yes	The path appended to the file system exported path that is mounted. For example if the export path is <code>nfsserver:/export/vmrepos</code> and <code>share_path</code> is set to <code>poola</code> then the full path on the mount would be <code>nfsserver:/export/vmrepos/poola</code>	Yes
<code>status</code>	String	Yes	Display friendly status for this mount point. (Mounted/Read-Only Mounted etc.)	No
<code>extra_info</code>	String	No	Open form opaque information that passed to/from the plug-in for use internally by the plug-in. The Oracle VM product does not look or try to interpret any of the information in this field.	Yes

## Backing Device

The `backing_device dict` is defined as follows:

Attribute name	Type	Allow Update	Description	Optional
<code>name</code>	String	Yes	This is the name of the volume group as defined on the Storage Server.	No
<code>total_sz</code>	Integer	Yes	The volume group's total size (in bytes).	No
<code>free_sz</code>	Integer	Yes	Amount of free space available in the volume group (in bytes).	No
<code>value</code>	String	Yes	This is the value the Storage Server requires to identify / use this specific backing device.	No
<code>description</code>	String	Yes	User friendly description for the File System backing device. If not supplied <code>name</code> will be used only.	Yes

## Appendix A

This following (Appendix A) is Sample Code and is licensed under the following terms and conditions:

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### Calling an external executable without using a temporary file

As can be seen below, instead of sending the output to a temporary file and then reading it back in, the output is send directly to the standard output pipe of the command which is then read directly into the `p_out` string. The returned string is parsed directly with the help of the `StringIO` class. This technique can be used for almost all external executable files as long as the executable support writing the output to a pipe and the amount of output is not too big (around 50K it is probably better to use a file)

```
# This is the SG_IO INQUIRY CDB
get_sg_inq = "12_00 00 00 60 00"

# Use sg_raw to get the LUN info from the device
p_cmd = ("/usr/bin/sg_raw "
        "--binary "
        "--nosense "
        "--request=96 "
        "--timeout=15 "
        "%s " +
```

```
        get_sg_inq) % dev_name
p_cmd = p_cmd.split(" ")
sgraw_p = subprocess.Popen(p_cmd,
                           stdout = subprocess.PIPE,
                           stderr = subprocess.PIPE)
(p_out, p_err) = sgraw_p.communicate()

# Successful?
if sgraw_p.returncode != 0:
    # Nope, throw an IO Error since we are doing raw scsi
    raise IOError("Unable to issue SG_IO INQ CDB: %s" % p_err)

# Use the StringIO class to read the string as file
sgraw_rdr = StringIO(p_out)

# Start of the expected vendor name
sgraw_rdr.seek(8)

# Read the vendor name
vendor = sgraw_rdr.read(8)
product = sgraw_rdr.read(16)
version = sgraw_rdr.read(4)

# Update the dict with all the values from the INQ CDB
lun_info["vendor"] = vendor.strip()
lun_info["product"] = product.strip()
lun_info["version"] = version.strip()
```

Below is a sample of calling an executable that returns the output in XML format and parsing the output inline from the resulting standard output string.

```
# Obtain the size
p_cmd = "sainq %s %s %s getsz %s" % (admin_host,
                                     admin_user,
                                     admin_passwd,
                                     dev_name)

p_cmd = p_cmd.split(" ")
sainq_p = subprocess.Popen(p_cmd,
                           stdout = subprocess.PIPE,
                           stderr = subprocess.PIPE)
(p_out, p_err) = sainq_p.communicate()

# Successful?
if sainq_p.returncode != 0:
    raise IOError("Unable to obtain the size: %s" % p_err)

# Add the XML header tags
xml_str = "<Head>\n%s\n</Head>" % p_out

# Create the XML element tree
xml_root = ElementTree.ElementTree(ElementTree.XML(str)).getroot()

# Get the size
for xml_obj in xml_root.findall("object"):
    size = xml_obj.findtext("size")
```

## Using a temporary file in a plug-in

```
# Obtain a named temporary file name
temp_file = IPlugin.getNamedTemporaryFile()

# Get the fully qualified name of the temporary file
temp_file_name = temp_file.name

# Use the file ...

# Close the file when done
temp_file.close()

# Make sure it is removed from the system
if os.path.exists(temp_file_name):
    os.remove(temp_file_name)
```

## Appendix B

### RPM spec file

```
#
# This file osc-oracle-sample.spec is Sample Code and is licensed under the
# following terms and conditions:
#
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#
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#    "This product includes software developed by Oracle."
#
# Alternately, this acknowledgment may appear in the software itself, if
# and wherever such third-party acknowledgments normally appear.
#
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#

#
# Oracle Storage Connect plugin sample .spec file
#

#####
#
# These defines need to be set to reflect the specific plugin
#
#####

%define      vendor_name      vendor
%define      plugin_module    sample
%define      plugin_version    1.0.0
%define      plugin_release    4
%define      plugin_description Oracle Storage Connect Sample plugin rpm.
%define      plugin_requires   None

Vendor:      Vendor Name
Summary:     Oracle Storage Connect Sample Plugin
```

URL: http://vendor.com/

License: GPLv2 / Whichever license the plugin should be released under  
BuildArch: noarch

```
#####  
#  
# If the plug-in is a split implementation (because some dependency)  
# set split_plugin to 'yes' and split_requires to any RPM dependencies.  
#  
# Note: When split_plugin is set, two RPMs will be generated, the normal  
#       osc-vendor-plugin-... one as well as the Meta package named  
#       osc-requirer-vendor-plugin-...  
#  
#####
```

```
%define      split_plugin      no  
%define      split_requires    None
```

```
#####  
#  
# The following defines are generic and should not need to be changed  
#  
#####
```

```
%define      dist              .el5  
%define      build_dir         %{_builddir}/%{name}-%{version}  
%define      plugin_dir        /opt/storage-connect/plugins  
%define      vendor_dir        %{plugin_dir}/%{vendor_name}  
%define      install_dir       %{vendor_dir}/%{plugin_module}
```

```
Name:        osc-%{vendor_name}-%{plugin_module}  
Version:     %{plugin_version}  
Release:     %{plugin_release}%{dist}  
Group:       Storage/StorageConnect  
Source0:     %{name}-%{version}.tar.bz2  
BuildRoot:   %{_tmppath}/%{name}-%{version}  
Requires:    osc-plugin-manager >= 1.2.0
```

```
%if %(test X%{plugin_requires} != XNone && echo 1 || echo 0)
```

```
Requires:    %{plugin_requires}
```

```
%endif
```

```
%if %(test X%{split_plugin} == Xyes && echo 1 || echo 0)
```

```
%package -n osc-requirer-%{vendor_name}-%{plugin_module}  
Vendor:     %{vendor}  
Summary:    Meta package for %{name}  
URL:        %{url}  
License:    %{license}
```

```
Version:     %{plugin_version}  
Release:     %{plugin_release}%{dist}  
Group:       %{group}  
Requires:    %{name} = %{plugin_version}-%{plugin_release}  
Requires:    %{split_requires}
```

```
%description -n osc-requirer-%{vendor_name}-%{plugin_module}  
Requirer package for %{name}
```

```
%files -n osc-requirer-%{vendor_name}-%{plugin_module}  
%defattr(0755, root, root)
```

```
%endif

%description
%{plugin_description}

%prep
%setup -q

%build

%install
rm -fr %{buildroot}
install -d -m0755 %{buildroot}/%{install_dir}
mv %{build_dir}/* %{buildroot}/%{install_dir}/.

%clean
rm -fr %{buildroot}

%files
%defattr(0755, root, root, 0755)
%attr(0755, root, root) /*

%preun
if [ $1 -eq 0 ]
then
    OSC_BIN=/opt/storage-connect/bin
    if [ -x "$OSC_BIN/announce_erase" ]
    then
        $OSC_BIN/announce_erase "%{name}" \
                                "%{version}-%{release}" \
                                "%{install_dir}" \
                                "%{vendor_name}" \
                                "%{plugin_module}"
    fi
    if [ -f %{vendor_dir}/__init__.py ]
    then
        python %{vendor_dir}/__init__.py %{vendor_dir} >/dev/null 2>&1
        if [ "$?" -eq 0 ]
        then
            rm -f %{vendor_dir}/__init__.py
            rm -f %{vendor_dir}/__init__.pyc
            rm -f %{vendor_dir}/__init__.pyo
        fi
    fi
fi
exit 0

%postun
if [ $1 -ge 1 ]
then
    OSC_BIN=/opt/storage-connect/bin
    if [ -x "$OSC_BIN/announce_upgrade" ]
    then
        $OSC_BIN/announce_upgrade "%{name}" \
                                    "%{version}-%{release}" \
                                    "%{install_dir}" \
                                    "%{vendor_name}" \
                                    "%{plugin_module}"
    fi
elif [ $1 -eq 0 ]
then
    rmdir --ignore-fail-on-non-empty %{install_dir}
    rmdir --ignore-fail-on-non-empty %{vendor_dir}
fi
exit 0
```



```
%post
OSC_BIN=/opt/storage-connect/bin
if [ -x "$OSC_BIN/announce_install" ]
then
    $OSC_BIN/announce_install "%{name}" \
                               "%{version}-%{release}" \
                               "%{install_dir}" \
                               "%{vendor_name}" \
                               "%{plugin_module}"
fi
if [ ! -f %{vendor_dir}/__init__.py ]
then
    cat >%{vendor_dir}/__init__.py <<__EOF__
"""
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            License along with this program; if not, write to the Free Software
            Foundation, Inc., 59 Temple Place - Suite 330, Boston,
            MA 02110-1307, USA

@summary:   This is just to enable the import of the plugins.
"""

#
# This is a major hack to get around RPM's limitation of not being able
# to specify the same file for multiple RPM installs
#
# Exit codes:
#   0 : No more dependencies
#   1 : ERROR condition
#   2 : Still have dependencies
#
if __name__ == '__main__':
    import sys
    import os
    if len(sys.argv) <= 1:
        print "ERROR: No vendor dir given!"
        sys.exit(1)

    try:
        vendor_dirs = os.listdir(sys.argv[1])
        ref_count = 0
        for vendor_dir in vendor_dirs:
            vendor_path = os.path.join(sys.argv[1], vendor_dir)
            if os.path.isdir(vendor_path):
                ref_count += 1

    except Exception, e:
        print "ERROR:", e
        sys.exit(1)

    if ref_count > 1:
        sys.exit(2)

    sys.exit(0)
```

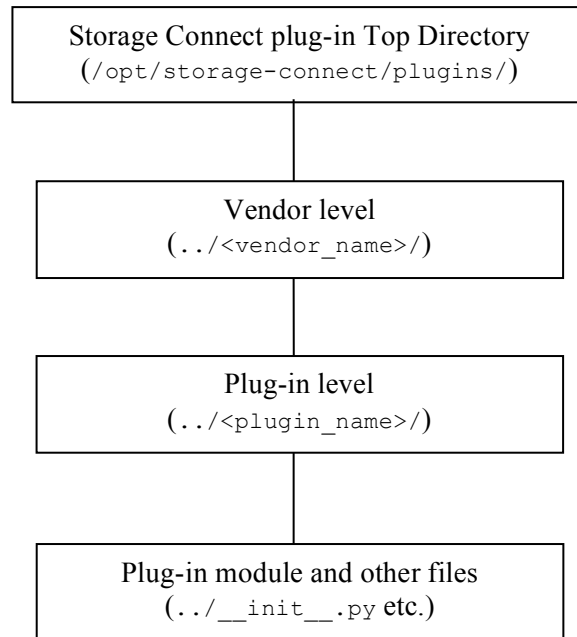
```
__EOF__  
fi  
exit 0
```

```
%changelog  
* Thu Jul 1 2010 Wiekus Beukes <wiekus.beukes@oracle.com> 1.0.0-4  
- Added requirer RPM generation  
- Updated the license  
  
* Fri Jun 4 2010 Wiekus Beukes <wiekus.beukes@oracle.com> 1.0.0-3  
- Fixed bug in the generated __init__.py  
  
* Wed Mar 3 2010 Wiekus Beukes <wiekus.beukes@oracle.com> 1.0.0-2  
- Removed ISA/IFS layer  
- Added the vendor directory __init__.py logic  
  
* Mon Nov 16 2009 Wiekus Beukes <wiekus.beukes@oracle.com> 1.0.0-1  
- Initial packaging
```

## Directory hierarchy

The directory hierarchy for a plug-in is as follows:

For example, the `gensa` plug-in the tar file listing is as follows:



```
osc-oracle-gensa-1.0.0/  
osc-oracle-gensa-1.0.0/OracleGenSCSI.py  
osc-oracle-gensa-1.0.0/GenStorageServer.py  
osc-oracle-gensa-1.0.0/OracleGenNFS.py  
osc-oracle-gensa-1.0.0/__init__.py
```