Plug-In SDK Guide for vRealize Orchestrator

Development Guide

TECHNICAL WHITE PAPER

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VERSION 1.0

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Overview

The Software Development Kit for Orchestrator plug-ins is a set of libraries and Maven archetypes that are distributed with every installation of vRealize Orchestrator. The Plug-in SDK provides a collection of interfaces for communicating with the Orchestrator platform and accessing different services.

SERVICE	DESCRIPTION
Configuration service	Stores data as configuration elements, such as host names, credentials, and others.
SSL service	Provides read access to the Trust store of the platform.
CAFÉ gateway service	Provides access to the CAFÉ services in vRealize Automation.
SSO REST client service	A service that is more generic than the CAFÉ gateway service.
Solution authentication service	Provides read access to the solution user token.
Scripting object contributor service	Makes possible for a plug-in to register scripting objects at runtime.
Cipher service	Encrypts and decrypts strings.

The Plug-in SDK is available as a Maven repository as part of the Orchestrator Appliance. You can access the repository at https://orchestrator_server_IP_or_DNS_name:8281/vco-repo/.

Configuration Service

Available in version 5.5.1 and later.

The Configuration service is included in the Orchestrator platform with version 5.5.1. This service makes it possible to store data as a resource. The configuration data consists of key-value pairs and supports `String`, `Password`, `Integer`, `Long`, `Decimal`, and `Boolean` data types.

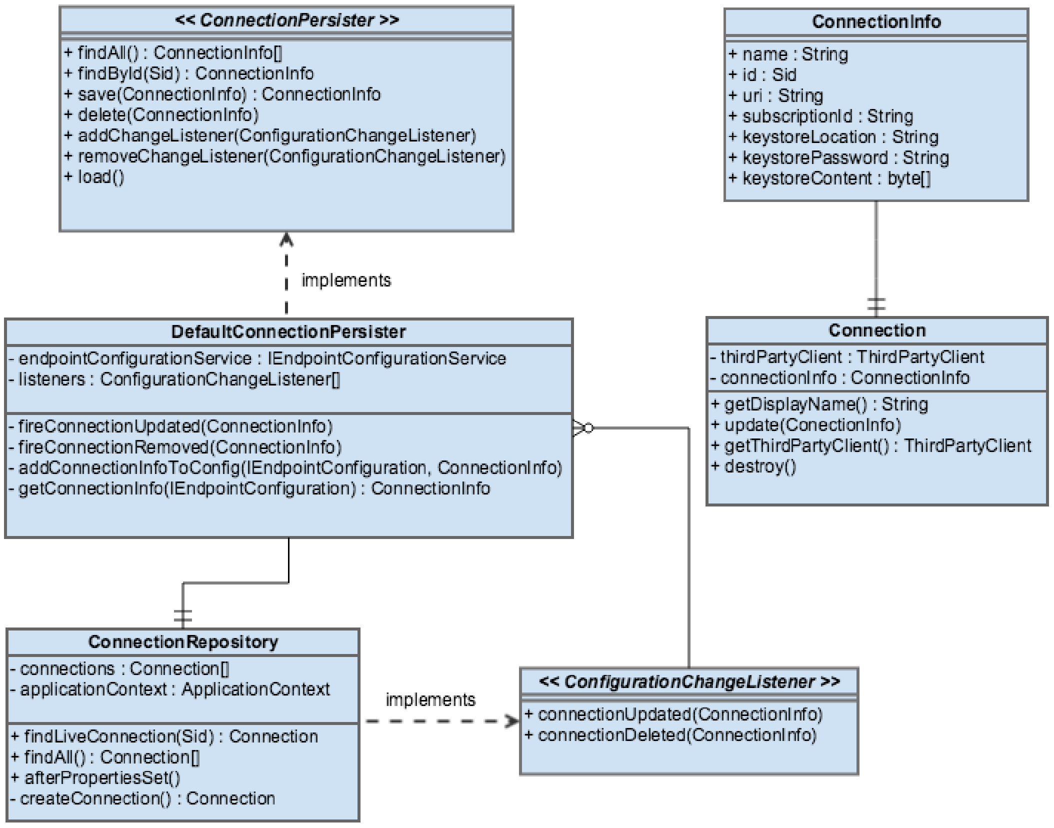
The `String` value serves multiple purposes. For example, if you want to store binary data, such as a keystore, as part of a configuration, you can encode the data in Base64.

The Configuration service includes two interfaces. If the plug-in uses a Spring context, the interfaces are injected. If the plug-in does not use Spring, the interfaces are retrieved from the service registry. In this case, you need two more interfaces to retrieve an instance of the Configuration service.

FROM ORCHESTRATOR VERSION	SERVICE	DESCRIPTION
5.5.1	IEndpointConfigurationService	Creates, reads, updates, and stores configurations as vRealize Orchestrator resources.

5.5.1	IEndpointConfiguration	Represents a single configuration that is stored as a vRealize Orchestrator resource.
5.5.1	IServiceRegistryAdaptor	An entry point to the `IServiceRegistry`. **NOTE** You should use this interface when the plug-in is not based on Spring.
5.5.1	IServiceRegistry	A service locator that provides Orchestrator services.

FIGURE 1 SHOWS A CLASS DIAGRAM OF A TYPICAL ORCHESTRATOR CONFIGURATION THAT THE CONFIGURATION SERVICE IMPLEMENTS.



<< ConnectionPersister >>
+ findAll() : ConnectionInfo[]
+ findById(Sid) : ConnectionInfo
+ save(ConnectionInfo) : ConnectionInfo
+ delete(ConnectionInfo)
+ addChangeListener(ConfigurationChangeListener)
+ removeChangeListener(ConfigurationChangeListener)
+ load()
ConnectionInfo
+ name : String
+ id : Sid
+ uri : String
+ subscriptionId : String
+ keystoreLocation : String
+ keystorePassword : String
+ keystoreContent : byte[]
implements
DefaultConnectionPersister
- endpointConfigurationService : IEndpointConfigurationService
- listeners : ConfigurationChangeListener[]
- fireConnectionUpdated(ConnectionInfo)
- fireConnectionRemoved(ConnectionInfo)
- addConnectionInfoToConfig(IEndpointConfiguration, ConnectionInfo)
- getConnectionInfo(IEndpointConfiguration) : ConnectionInfo
Connection
- thirdPartyClient : ThirdPartyClient
- connectionInfo : ConnectionInfo
+ getDisplayName() : String
+ update(ConectionInfo)
+ getThirdPartyClient() : ThirdPartyClient
+ destroy()
ConnectionRepository
- connections : Connection[]
- applicationContext : ApplicationContext
+ findLiveConnection(Sid) : Connection
+ findAll() : Connection[]
+ afterPropertiesSet()
- createConnection() : Connection
implements
<< ConfigurationChangeListener >>
+ connectionUpdated(ConnectionInfo)
+ connectionDeleted(ConnectionInfo)

Creating ConnectionInfo

`ConnectionInfo` is a simple plain old Java object (POJO) that holds all data required to create or configure a connection to a third-party system.

NOTE `ConnectionInfo` is not the actual connection, or scripting object, but rather the data that represents the object.

```
public class ConnectionInfo {

    /*
     * Name of the connection
     */
    private String name;

    /*
     * ID of the connection - can be String, UUID or whatever type you find
suitable.
     */
    private final Sid id;

    /*
     * Service URI of the third party system
     */
    private String uri;

    private String subscriptionId;
    private String keystoreLocation;

    /*
     * Sensitive data - the keystore password
     */
    private String keystorePassword;

    /*
     * Some binary content - in this case we save a keystore
     */
    private byte[] keystoreContent;

    /*
     * Verify that each ConnectionInfo has an ID.
     */
    public ConnectionInfo() {
        this.id = Sid.unique();
    }

    /*
     * Verify that each ConnectionInfo has an ID.
     */
    public ConnectionInfo(Sid id) {
        super();
        this.id = id;
    }

    /*
     * Getters and setters
     */
    public String getUri() {
        return uri;
    }
    public void setUri(String uri) {
        this.uri = uri;
    }
    public String getSubscriptionId() {
        return subscriptionId;
    }
    public void setSubscriptionId(String subscriptionId) {
        this.subscriptionId = subscriptionId;
    }
    public String getKeystoreLocation() {
        return keystoreLocation;
    }
    public void setKeystoreLocation(String keystoreLocation) {
        this.keystoreLocation = keystoreLocation;
    }
    public String getKeystorePassword() {
        return keystorePassword;
    }
    public void setKeystorePassword(String keystorePassword) {
        this.keystorePassword = keystorePassword;
    }
    public Sid getId() {
        return id;
    }
    public String getName() {
        return name;
    }
    public void setName(String name) {
        this.name = name;
    }
    public byte[] getKeystoreContent() {
        return keystoreContent;
    }
    public void setKeystoreContent(byte[] keystoreContent) {
        this.keystoreContent = keystoreContent;
    }

    /*
     * It is always a good idea to expose the fields of that object for logging
and debugging purposes.
     * Do not print the password.
     */
    @Override
    public String toString() {
        return "ConnectionInfo [name=" + name + ", id=" + id + ", uri=" + uri +
", subscriptionId=" + subscriptionId
                + ", keystoreLocation=" + keystoreLocation + "]";
    }
}
```

Creating the Configuration Change Listener

The configuration change listener is an extension point of the configuration persister, which is the interface that stores the data. With the configuration change listener, other components can subscribe to configuration events, such as update or delete a `ConnectionInfo` object.

Normally, the Orchestrator plug-ins store all live connections and sessions in the memory, as a self-managed cache. In this way, you can make sure that only a single instance of a connection or session exists. If another user updates or deletes this connection instance, by using the `ConnectionPersister` interface, the cache that stores the live connections or sessions, enters in an inconsistent state.

You can implement the observer pattern to prevent such a situation.

```
public interface ConfigurationChangeListener {
    /*
     * Invoked when the ConnectionInfo input is updated
     */

    void connectionUpdated(ConnectionInfo info);
    /*
     * Invoked when the ConnectionInfo input is deleted
     */
    void connectionRemoved(ConnectionInfo info);
}
```

Connection Persister

ConnectionPersister is a class that creates, reads, updates, and deletes the ConnectionInfo objects. ConnectionPersister is a wrapper of IEndpointConfigurationService and hides the conversions between IEndpointConfigurationService and ConnectionInfo.

Defining the Configuration Persister Interface

```
public interface ConnectionPersister {
    /*
     * Returns a collection of all stored configurations (resources under
     * a folder with the plug-in name)
     */
    public List<ConnectionInfo> findAll();
    /*
     * Returns a collection by its ID or null if not found
     */
    public ConnectionInfo findById(Sid id);
    /*
     * Stores a connection info or updates it if already available.
     * The persister checks the availability of a connection by its ID
     */
    public ConnectionInfo save(ConnectionInfo connection);
    /*
     * Deletes a connection info. The persister will use the ID of the
connection
     */
    public void delete(ConnectionInfo connectionInfo);
    /*
     * Allows us to subscribe to the events of the persister.
     * For example, if a connection is deleted, the persister will
     * trigger an event, notifying all subscribers.
     * This is an implementation of the observer pattern.
     */
    void addChangeListener(ConfigurationChangeListener listener);
    /*
     * Forces the persister to read all the configurations and trigger
     * the events. This method is invoked when the plug-in is loaded
     * on server start-up.
     */
    public void load();
}
```

Implementing the Default Connection Persister Interface

```
@Component
public class DefaultConnectionPersister implements ConnectionPersister {
    private static final String CHARSET = "UTF-8";

    /*
```

```
     * A list of listeners, who have subscribed to any configuration events,
such as
     * connection updates and deletions.
     */
    private final Collection<ConfigurationChangeListener> listeners;

    /*
     * Always use loggers
     */
    private static final Logger log =
LoggerFactory.getLogger(DefaultConnectionPersister.class);


    /*
     * Constants of the key names under which the connection values will be
stored.
     */
    private static final String ID = "connectionId";
    private static final String NAME = "name";
    private static final String SUBSCRIPTION_ID = "sunscriptionId";
    private static final String KEYSTORE_CONTENT = "keystoreContent";
    private static final String KEYSTORE_PASSWORD = "keystorePassword";
    private static final String SERVICE_URI = "serviceUri";

    /*
     * The IEndpointConfigurationService will be injected through spring
     * if the plug-in has a spring context.
     */
    @Autowired
    private IEndpointConfigurationService endpointConfigurationService;

    /*
     * Persister constructor
     */
    public DefaultConnectionPersister() {
        //Initialize the listeners
        listeners = new CopyOnWriteArrayList<ConfigurationChangeListener>();
    }

    /*
     * Returns a collection of all stored configurations for this plug-in only
     * The service is aware of the plug-in name, thus will return only
configurations for this plug-in.
     */
    @Override
    public List<ConnectionInfo> findAll() {
        Collection<IEndpointConfiguration> configs;
        try {
            //Use the configuration service to retrieve all configurations.
            //The service is aware of the plug-in name, thus will return only
configurations for this plug-in.
            configs =
endpointConfigurationService.getEndpointConfigurations();
            List<ConnectionInfo> result = new ArrayList<>(configs.size());

            //Iterate all the connections
            for (IEndpointConfiguration config : configs) {
                //Convert the IEndpointConfiguration to our domain object -
the ConnectionInfo
                ConnectionInfo connectionInfo = getConnectionInfo(config);
                if (connectionInfo != null) {
                    log.debug("Adding connection info to result map: " +
connectionInfo);
                    result.add(connectionInfo);
                }
            }
            return result;
        } catch (IOException e) {
            log.debug("Error reading connections.", e);
            throw new RuntimeException(e);
        }
    }

    /*
     * Returns a ConnectionInfo by its ID
     * The service is aware of the plug-in name, thus cannot return a
configuration for another plug-in.
     */
    @Override
    public ConnectionInfo findById(Sid id) {
        //Sanity checks
        Validate.notNull(id, "Sid cannot be null.");

        IEndpointConfiguration endpointConfiguration;
        try {
            //Use the configuration service to retrieve the configuration
service by its ID
            endpointConfiguration =
endpointConfigurationService.getEndpointConfiguration(id.toString());

            //Convert the IEndpointConfiguration to our domain object - the
ConnectionInfo
            return getConnectionInfo(endpointConfiguration);
        } catch (IOException e) {
            log.debug("Error finding connection by id: " + id.toString(), e);
            throw new RuntimeException(e);
        }
    }

    /*
     * Save or update a connection info.
     * The service is aware of the plug-in name, thus cannot save the
configuration
     * under the name of another plug-in.
     */
    @Override
    public ConnectionInfo save(ConnectionInfo connectionInfo) {
        //Sanity checks
        Validate.notNull(connectionInfo, "Connection info cannot be null.");
        Validate.notNull(connectionInfo.getId(), "Connection info must have an
id.");

        //Additional validation - in this case we want the name of the
connection to be unique
        validateConnectionName(connectionInfo);
        try {
            //Find a connection with the provided ID. We don't expect to have
an empty ID
            IEndpointConfiguration endpointConfiguration =
endpointConfigurationService
```

```
.getEndpointConfiguration(connectionInfo.getId().toString());
            //If the configuration is null, then we are performing a save
operation
            if (endpointConfiguration == null) {
                //Use the configuration service to create a new (empty)
IEndpointConfiguration.
                //In this case, we are responsible for assigning the ID of the
configuration,
                //which is done in the constructor of the ConnectionInfo
                endpointConfiguration =
endpointConfigurationService.newEndpointConfiguration(connectionInfo.getId()
                        .toString());
            }

            //Convert the ConnectionInfo the IEndpointConfiguration
            addConnectionInfoToConfig(endpointConfiguration, connectionInfo);

            //Use the configuration service to save the endpoint configuration

endpointConfigurationService.saveEndpointConfiguration(endpointConfiguration);

            //Fire an event to all subscribers, that we have updated a
configuration.
            //Pass the entire connectionInfo object and let the subscribers
decide if they need to do something
            fireConnectionUpdated(connectionInfo);
            return connectionInfo;
        } catch (IOException e) {
            log.error("Error saving connection " + connectionInfo, e);
            throw new RuntimeException(e);
        }
    }

    /*
     * Delete a connection info. The service is aware of the plug-in name,
thus cannot delete a configuration
     * from another plug-in.
     */
    @Override
    public void delete(ConnectionInfo connectionInfo) {
        try {
            //Use the configuration service to delete the connection info. The
service uses the ID

endpointConfigurationService.deleteEndpointConfiguration(connectionInfo.getId(
).toString());

            //Fire an event to all subscribers, that we have deleted a
configuration.
            //Pass the entire connectionInfo object and let the subscribers
decide if they need to do something
            fireConnectionRemoved(connectionInfo);
        } catch (IOException e) {
            log.error("Error deleting endpoint configuration: " +
connectionInfo, e);
            throw new RuntimeException(e);
        }
    }
    /*
     * This method is used to load the entire configuration set of the plug-
in.
     * As a second step we fire a notification to all subscribers. This method
     * is used when the plug-in is being loaded (on server startup).
     */
    @Override
    public void load() {
        List<ConnectionInfo> findAll = findAll();
        for (ConnectionInfo connectionInfo : findAll) {
            fireConnectionUpdated(connectionInfo);
        }
    }

    /*
     * Attach a configuration listener.
     */
    @Override
    public void addChangeListener(ConfigurationChangeListener listener) {
        listeners.add(listener);
    }

    /*
     * A helper method which iterates all event subscribers and fires the
     * update notification for the provided connection info.
     */
    private void fireConnectionUpdated(ConnectionInfo connectionInfo) {
        for (ConfigurationChangeListener li : listeners) {
            li.connectionUpdated(connectionInfo);
        }
    }

    /*
     * A helper method which iterates all event subscribers and fires the
     * delete notification for the provided connection info.
     */
    private void fireConnectionRemoved(ConnectionInfo connectionInfo) {
        for (ConfigurationChangeListener li : listeners) {
            li.connectionRemoved(connectionInfo);
        }
    }

    /*
     * A helper method which converts our domain object the ConnectionInfo to
an IEndpointConfiguration
     */
    private void addConnectionInfoToConfig(IEndpointConfiguration config,
ConnectionInfo info) {
        try {
            config.setString(ID, info.getId().toString());
            config.setString(NAME, info.getName());
            config.setString(SUBSCRIPTION_ID, info.getSubscriptionId());
            config.setString(KEYSTORE_CONTENT, new
String(info.getKeystoreContent(), CHARSET));
            config.setPassword(KEYSTORE_PASSWORD, info.getKeystorePassword());
            config.setString(SERVICE_URI, info.getUri());
        } catch (UnsupportedEncodingException e) {
            log.error("Error converting ConnectionInfo to
IEndpointConfiguration.", e);
            throw new RuntimeException(e);
        }
    }

    /*
     * A helper method which converts the IEndpointConfiguration to our domain
object the ConnectionInfo
     */
    private ConnectionInfo getConnectionInfo(IEndpointConfiguration config) {
        ConnectionInfo info = null;
        try {
            Sid id = Sid.valueOf(config.getString(ID));
            info = new ConnectionInfo(id);
            info.setName(config.getString(NAME));
            info.setUri(config.getString(SERVICE_URI));
            info.setSubscriptionId(config.getString(SUBSCRIPTION_ID));
            info.setKeystorePassword(config.getPassword(KEYSTORE_PASSWORD));

info.setKeystoreContent(config.getString(KEYSTORE_CONTENT).getBytes(CHARSET));
        } catch (IllegalArgumentException | UnsupportedEncodingException e) {
            log.warn("Cannot convert IEndpointConfiguration to ConnectionInfo:
" + config.getId(), e);
        }
        return info;
    }
    private void validateConnectionName(ConnectionInfo connectionInfo) {
        ConnectionInfo configurationByName =
getConfigurationByName(connectionInfo.getName());
        if (configurationByName != null
                &&
!configurationByName.getId().toString().equals(connectionInfo.getId().toString
())) {
            throw new RuntimeException("Connection with the same name already
exists: " + connectionInfo);
        }
    }
    private ConnectionInfo getConfigurationByName(String name) {
        Validate.notNull(name, "Connection name cannot be null.");
        Collection<ConnectionInfo> findAllClientInfos = findAll();
        for (ConnectionInfo info : findAllClientInfos) {
            if (name.equals(info.getName())) {
                return info;
            }
        }
        return null;
    }
}
```

Connection Repository

`ConnectionRepository` acts as local cache of a plug-in because it keeps all live connections. Any read operation that is related to a live connection must pass through the `ConnectionRepository` interface.

```
/*
 * The ConnectionRepository implements the ConfigurationChangeListener, because
we want to be subscribed to all
 * changes related to configurations. ApplicationContextAware and
InitializingBean are spring-related interfaces.
 */
@Component
```

```
public class ConnectionRepository implements ApplicationContextAware,
InitializingBean, ConfigurationChangeListener {


    /*
     * Injecting the ConnectionPersister
     */
    @Autowired
    private ConnectionPersister persister;

    private ApplicationContext context;

    /*
     * The local map (cache) of live connections
     */
    private final Map<Sid, Connection> connections;

    public ConnectionRepository() {
        connections = new ConcurrentHashMap<Sid, Connection>();
    }

    /*
     * The public interface returns a live connection by its ID
     */
    public Connection findLiveConnection(Sid anyId) {
        return connections.get(anyId.getId());
    }

    /*
     * The public interface returns all live connections from the local cache
     */
    public Collection<Connection> findAll() {
        return connections.values();
    }

    /*
     * Spring-specifics - storing a reference to the spring context
     */
    @Override
    public void setApplicationContext(ApplicationContext context) throws
BeansException {
        this.context = context;
    }

    /*
     * Spring specifics - this method is being called automatically by the
spring container
     * after all the fields are set and before the bean is being provided for
usage.
     * This method will be called when the plug-in is being loaded - on server
start-up.
     */
    @Override
    public void afterPropertiesSet() throws Exception {
        //Subscribing the Repository for any configuration changes that occur
in the Persister
        persister.addChangeListener(this);

        //Initializing the Persister. By doing that, the persister will invoke
the connectionUpdated() method
```

```
        //and since we are subscribed to those events, the local cache will be 
populated with all the available connections.
        persister.load();
    }

    private Connection createConnection(ConnectionInfo info) {
        //This call will create a new spring-managed bean from the context
        return (Connection) context.getBean("connection", info);
    }

    /*
     * This method will be called from the ConnectionPersister when a new 
connection
     * is added or an existing one is updated.
     */
    @Override
    public void connectionUpdated(ConnectionInfo info) {
        Connection live = connections.get(info.getId());
        if (live != null) {
            live.update(info);
        } else {
            // connection just added, create it
            live = createConnection(info);
            connections.put(info.getId(), live);
        }
    }

    /*
     * This method will be called from the ConnectionPersister when a 
connection
     * is removed.
     */
    @Override
    public void connectionRemoved(ConnectionInfo info) {
        Connection live = connections.remove(info.getId());
        if (live != null) {
            live.destroy();
        }
    }
}
```

The difference between `ConnectionPersister` and `ConnectionRepository` is that the persister manages only the `ConnectionInfo` POJOs that remain behind the live connections, whereas `ConnectionRepository` provides the same instance of a third-party connection. In other words, `ConnectionRepository` handles connections and `ConnectionPersister` handles `ConnectionInfo` objects.

`ConnectionRepository` provides two methods - `findLiveConnection(..)` and `findAll(..)`. If you want to edit or delete a connection from the repository, you use the `ConnectionPersister` interface.

When the persister updates or deletes a connection, the change propagates to the repository because `ConnectionRepository` is subscribed to update or delete events that `ConnectionPersister` handles.

Connection

The `Connection` object that represents a live connection. There must be only a single `Connection` object instance per connection. The connection instances are stored in `ConnectionRepository`.

```
@Component
@Qualifier(value = "connection")
```

```
@Scope(value = "prototype")
public class Connection {
    /*
     * Some third party client which enables the communications between
     * vRO and the third party system. Can be a http client, SSH client etc.
     */
    private ThirdPartyClient thirdPartyClient;
    /*
     * The connectionInfo which stands behind this live connection.
     */
    private ConnectionInfo connectionInfo;
    /*
     * There is no default constructor, the Connection must be
     * initialized only with a connection info argument.
     */
    public Connection(ConnectionInfo info) {
        init(info);
    }
    public synchronized ConnectionInfo getConnectionInfo() {
        return connectionInfo;
    }
    public String getDisplayName() {
        return getConnectionInfo().getName() + " [" +
getConnectionInfo().getSubscriptionId() + "]";
    }
    /*
     * Updates this connection with the provided info. This operation will
     * destroy the existing third party client, causing all associated
operations to fail.
     */
    public synchronized void update(ConnectionInfo connectionInfo) {
        if (this.connectionInfo != null &&
!connectionInfo.getId().equals(this.connectionInfo.getId())) {
            throw new IllegalArgumentException("Cannot update using different
id");
        }
        destroy();
        init(connectionInfo);
    }
    private void init(ConnectionInfo connectionInfo) {
        this.connectionInfo = connectionInfo;
    }
    /*
     * Lazy-initializes the ThirdPartyClient instance
     */
    public synchronized ThirdPartyClient getThirdPartyClient() {
        if (thirdPartyClient == null) {
            thirdPartyClient = new ThirdPartyClient();
            //Use the connectionInfo to setup the ThirdPartyClient properties
            //thirdPartyClient.set(..);
        }
        return thirdPartyClient;
    }
    public synchronized void destroy() {
        //Destroy the client, releasing all current connections and
        //possibly cleaning the resources.
        thirdPartyClient.close();
        //Set the client to null so that it can be reinitialized by the
        //getThirdPartyClient() method
        thirdPartyClient = null;
    }
}
```

Implement a Cluster Awareness of Configurations

vRealize Orchestrator instances can work in a cluster, which involves transferring configuration data between the clustered nodes. When you make a configuration change, for example, add an inventory object on one of the nodes in the cluster, this change does not automatically propagate to the workflow engines of the rest of the nodes.

The Orchestrator plug-in must contain a code that fulfills a set of requirements.

1. Detect that a change has been applied.

The `IEndpointConfigurationService.getVersion()` method returns the current version of the configuration data in the database.

The following code detects the change, by comparing the existing version to the one that is stored in the database.

```
public class DefaultConnectionPersister implements ConnectionPersister {

    @Autowired
    private IEndpointConfigurationService cachingEndpointConfigurationService;

    private String configurationVersion;

    public boolean changed() throws IOException {
        return configurationVersion == null || configurationVersion.isEmpty()
||
!configurationVersion.equals(cachingEndpointConfigurationService.getVersion());
    }

}
```

This check is invoked every time an object that depends on the configuration data is accessed.

2. If the check detects a change, load configuration data.

NOTE The Orchestrator platform caches the `IEndpointConfigurationService.getVersion()` method. The caching interval is different depending on the version of Orchestrator.

a. If the Orchestrator version is 7.0.0 or later, the maximum caching interval is two heart-beat intervals.

For example, if the heart-beat interval is five seconds and a configuration change occurs on Node1, calling the `getVersion()` method on the other nodes returns a cached value for a maximum period of 10 seconds.

b. If the Orchestrator version is earlier than 7.0.0, the platform does not cache the version.

In this case, caching is additionally provided and the TTL (Time To Live) interval is 10 seconds.

IEndpointConfigurationService Implementation

During the plug-in development, you must implement `IEndpointConfigurationService` in such a way, that the `IEndpointConfigurationService.getVersion()` method can work on all versions of Orchestrator.

1. Make sure the plug-in depends on platform version 7.0.0 or later.
2. In the Maven `pom.xml` file, add a compile-time dependency to the `o11n-plugin-tools` artifact, so that the plug-in package includes the artifact.

```
<dependency>
   <groupId>com.vmware.o11n</groupId>
   <artifactId>o11n-plugin-tools</artifactId>
   <version>${vco.version}</version>
</dependency>
```

3. Implement `IEndpointConfigurationService` depending on the type of the plug-in.

For Spring-based plug-ins, the name of the component is `cachingEndpointConfigurationService`.

a. The name the property must be `cachingEndpointConfigurationService`.

```
@Autowired
private IEndpointConfigurationService cachingEndpointConfigurationService;
```

b. Add the application content XML to the plug-in.

```
<context:component-scan base-
package="com.vmware.o11n.plugin.sdk.endpoints.extensions" annotation-
config="true"/>
```

For plug-ins that are not Spring-based, search the correct version, for example, in the `setServiceRegistry` method.

```
endpointConfigurationService =
EndpointConfigurationServiceFactory.lookupEndpointConfigurationService(registry
);
```

4. Reload the configuration data.

By fetching all data through `endpointConfiguratonService`, find the changed entries on the other nodes.

5. Update the state of the inventory objects according to the loaded configuration data.

Reading Configuration Files of Other Plug-Ins

FROM ORCHESTRATOR VERSION	SERVICE	DESCRIPTION
5.5.1	IEndpointConfigurationService	Creates, reads, updates and stores configurations as vRealize Orchestrator resources.
5.5.1	IEndpointConfiguration	Represents a single configuration that is stored as a vRealize Orchestrator resource.

NOTE Some plug-ins rely on the configuration files of other plug-ins.

With `IEndpointConfigurationService`, you can retrieve a read-only configuration of another plug-in.

```
import java.io.IOException;
import java.util.ArrayList;
import java.util.List;
import org.springframework.beans.factory.annotation.Autowired;
import ch.dunes.vso.sdk.endpoints.IEndpointConfiguration;
import ch.dunes.vso.sdk.endpoints.IEndpointConfigurationService;

//Reader for vCenter configurations
public class VcenterConnectionReader {

    @Autowired
    private IEndpointConfigurationService endpointConfigurationService;
    public List<VcHost> loadVcPluginHosts() throws IOException {
        List<VcHost> hosts = new ArrayList<VcHost>();
        try {
            //Read the configuration of another plug-in by its name

endpointConfigurationService.getEndpointConfigurationServiceForPlugin("VC");

            //Iterate through the IEndpointConfiguration objects and construct
your own model objects
            for (IEndpointConfiguration configuration :
endpointConfigurationService.getEndpointConfigurations()) {
                String passwordEncrypted =
configuration.getPassword("administratorPassword");
                Boolean isSharedLoginMode =
configuration.getAsBoolean("sharedLoginMode");
                String administratorUsername =
configuration.getString("administratorUsername");
                Boolean isEnabled = configuration.getAsBoolean("enabled");
                String url = configuration.getString("url");
                VcHost vcHost = new VcHost();
                vcHost.setActive(isEnabled);
                vcHost.setPassword(passwordEncrypted);
                vcHost.setUsername(administratorUsername);
                vcHost.setSharedLoginMode(isSharedLoginMode);
                vcHost.setVcUri(url);
                if (isEnabled) {
                    hosts.add(vcHost);
                }
            }
        } catch (Exception e) {
            throw new RuntimeException(e);
        }
        return hosts;
    }

    //A model class representing vCenter connections
    public class VcHost {
        private Boolean isEnabled;
        private String url;
        private Boolean isSharedLoginMode;
        private String administratorUsername;
        private String passwordEncrypted;
        public Boolean getIsEnabled() {
            return isEnabled;
        }
        public void setIsEnabled(Boolean isEnabled) {
            this.isEnabled = isEnabled;
        }
        public String getUrl() {
            return url;
        }
        public void setUrl(String url) {
            this.url = url;
        }
        public Boolean getIsSharedLoginMode() {
            return isSharedLoginMode;
        }
        public void setIsSharedLoginMode(Boolean isSharedLoginMode) {
            this.isSharedLoginMode = isSharedLoginMode;
        }
        public String getAdministratorUsername() {
            return administratorUsername;
        }
        public void setAdministratorUsername(String administratorUsername) {
            this.administratorUsername = administratorUsername;
        }
        public String getPasswordEncrypted() {
            return passwordEncrypted;
        }
        public void setPasswordEncrypted(String passwordEncrypted) {
            this.passwordEncrypted = passwordEncrypted;
        }
        public void setActive(Boolean isEnabled) {
            this.isEnabled = isEnabled;
        }
        public void setVcUri(String url) {
            this.url = url;
        }
        public void setSharedLoginMode(Boolean isSharedLoginMode) {
            this.isSharedLoginMode = isSharedLoginMode;
        }
        public void setUsername(String administratorUsername) {
            this.administratorUsername = administratorUsername;
        }
        public void setPassword(String passwordEncrypted) {
            this.passwordEncrypted = passwordEncrypted;
        }
    }
}
```

SSL Service

Available in version 5.5.1 and later.

The SSL service is a platform service that provides read-only access to the trust store files of the Orchestrator servers.

Several workflows can write to the Orchestrator trust store. These workflows are part of the Orchestrator platform.

You can use these workflows in the configuration workflows of plug-ins that require establishing an SSL/TLS connection to the third-party system.

WORKFLOW	DESCRIPTION
Library > Configuration > SSL Trust Manager > Import a certificate from URL	Imports a trusted certificate from a remote URL. The certificate is imported with an automatically generated alias.
Library > Configuration > SSL Trust Manager > Import a certificate from URL using proxy server	Imports a trusted certificate from a remote URL through a proxy server. The certificate is imported with an automatically generated alias.

Library > Configuration > SSL Trust Manager > Import a certificate from URL with certificate alias	Imports a trusted certificate from a remote URL. The certificate is imported with a specified alias.
Library > Configuration > SSL Trust Manager > Import a trusted certificate from a file	Imports a trusted certificate from a file. The file must be in a DER format.

Retrieve sslService from Service Registry

1. With a plug-in, you invoke the `getService()` method from `IServiceRegistry` and retrieve an `ISslService` interface.

NOTE If the plug-in is Spring-based, you can define the service dependencies, or auto-wire, `ISslService`.

```
import ch.dunes.vso.sdk.IServiceRegistryAdaptor;
import ch.dunes.vso.sdk.ssl.ISslService;

public final class PluginAdaptor implements IServiceRegistryAdaptor {
    @Override
    public void setServiceRegistry(IServiceRegistry registry) {
        ISslService sslService = (ISslService)
registry.getService(IServiceRegistry.SSL_SERVICE);
    }
}
```

2. After you retrieve the `sslService`, assign the service reference as a field.

In this way, the plug-in does not search in the registry, every time it uses the service. `sslService` provides two interfaces - `SslContext` and `HostNameVerifier`.

```
public interface ISslService {
    SSLContext newSslContext(String protocol) throws NoSuchAlgorithmException;

    HostnameVerifier newHostNameVerifier();
}
```

3. Create a new `SslContext` object and specify the desired protocol.

```
SSLContext sslContext = sslService.getSslContext("SSL");
```

4. Create an `SSLSocketFactory` class.

```
SSLSocketFactory factory = sslContext.getSocketFactory();
```

The factory class creates a socket with some specified options: `host`, `port`, `autoClose`, `localAddress`, `localPort`, and `localhost`.

5. Set `SSLSocketFactory` to an HTTPS connection.

```
URL url = new URL(serverUrl); //a string with some serverUrl
URLConnection connection = url.openConnection();
HttpsURLConnection httpsConnection = (HttpsURLConnection) connection;
SSLContext sslContext = sslService.newSslContext("SSL");
httpsConnection.setSSLSocketFactory(sslContext.getSocketFactory());
httpsConnection.setHostnameVerifier(sslService.newHostNameVerifier());
```

6. When a `URLConnection` is open, use the `HostNameVerifier` interface.

```
URL url = new URL(serverUrl); //a string with some serverUrl
URLConnection connection = url.openConnection();
HostnameVerifier hostnameVerifier = sslService.newHostNameVerifier();
((HttpsURLConnection) connection).setHostnameVerifier(hostnameVerifier);
```

CAFÉ Gateway Service

Available in version 5.5.2 and later.

The CAFÉ gateway service is a limited version of the SSO REST client service that exposes the `RestClient` class of the CAFÉ endpoints.

This service creates a preconfigured `RestClient` that communicates with the CAFÉ services in vRealize Automation. You can access the CAFÉ gateway service, no matter if the plug-in is Spring-enabled or not.

1. Access the service.
   a. If the plug-in is Spring-enabled:

```
//Object must be declared in the spring context
public class MyDomainObject {

    @Autowired
    private CafeGateway cafeGateway;

}
```

   b. If the plug-in is not Spring-enabled:

```
import ch.dunes.vso.sdk.cafe.CafeGateway;

public class PluginAdaptor implements IServiceRegistryAdaptor {

    private IServiceRegistry registry;
    private CafeGateway cafeGateway;

    @Override
    public void setServiceRegistry(IServiceRegistry registry) {
        this.registry = registry;
    }

    public CafeGateway getCafeGateway() {
        if (cafeGateway == null) {
            cafeGateway = (CafeGateway)
registry.getService(IServiceRegistry.CAFE_GATEWAY_SERVICE);
        }
        return cafeGateway;
    }

}
```

2. Build a `ScriptingObjectDefinition` to read log events from vRealize Automation.

```
import org.springframework.data.domain.PageRequest;

import org.springframework.data.domain.Pageable;
import com.vmware.vcac.core.eventlog.rest.client.service.EventLogService;
import com.vmware.vcac.eventlog.rest.stubs.Event;
import com.vmware.vcac.platform.data.services.RegistryCatalog;
import com.vmware.vcac.platform.rest.client.RestClient;
import com.vmware.vcac.platform.rest.data.PagedResources;

//Provided the service is already instantiated
CafeGateway cafeGateway;

//Retrieve a rest client from the gateway service
RestClient restClient =
cafeGateway.restClientForSolutionUserByServiceAndEndpointType(
    RegistryCatalog.EVENTLOG_SERVICE.getServiceTypeId(),
    RegistryCatalog.EVENTLOG_SERVICE.getDefaultEndPointTypeId());


//Instantiate the service object with the newly created rest client
EventLogService service = new EventLogService(restClient);

//Create a pageable request
Pageable pageable = new PageRequest(1, 15);

//Request the events
PagedResources<Event> page = service.getAllEvents(pageable);


//Get the content of the page
Collection<Event> events = page.getContent();
```

SSO REST Client Service

Available in version 6.0.1 and later.

The SSO REST client service is a more extended version of the CAFÉ gateway service that exposes the `RestClient` class of the CAFÉ endpoints. With this service, you can specify the host and the root path of the REST client, instead of just communicating with a CAFÉ server that is configured as an authentication provider.

You can access the SSO REST client service, no matter if the plug-in is Spring-enabled or not.

1. Access the service.
    a. If the plug-in is Spring-enabled:

```
//Object must be declared in the spring context
public class MyDomainObject {

    @Autowired
    private SsoRestClientFactory restClientFactory;

}
```

    b. If the plug-in is not Spring-enabled:

```
public class PluginAdaptor implements IServiceRegistryAdaptor {

    private IServiceRegistry registry;
    private SsoRestClientFactory ssoRestClientFactory;

    @Override
    public void setServiceRegistry(IServiceRegistry registry) {
        this.registry = registry;
    }

    public SsoRestClientFactory getSsoRestClientService() {
        if (ssoRestClientFactory == null) {
            this.ssoRestClientFactory = (SsoRestClientFactory)
registry.getService(IServiceRegistry.SSO_REST_CLIENT_SERVICE));
        }
        return ssoRestClientFactory;
    }
}
```

2. Create a SAML authentication session.

```
import com.vmware.o11n.sdk.rest.client.authentication.Authentication;
import com.vmware.o11n.sdk.rest.client.VcoSessionOverRestClient;
import com.vmware.o11n.sdk.rest.client.configuration.ConnectionConfiguration;
import com.vmware.o11n.plugin.vcoconn.config.ServerConfigurationManager;
import ch.dunes.vso.sdk.cafe.SsoRestClientFactory;
import ch.dunes.vso.sdk.IServiceRegistry;
import ch.dunes.vso.sdk.api.ISamlToken;

public class SampleSessionFactory implements VcoSessionFactory {
    private IServiceRegistry registry;
    private SsoRestClientFactory ssoRestClientFactory;

    public SampleSessionFactory (URI uri, ConnectionConfiguration
connectionConfiguration) {
        IServiceRegistry registry =
ServerConfigurationManager.getInstance().getServiceRegistry();
        this.ssoRestClientFactory = ((SsoRestClientFactory) registry
                .getService(IServiceRegistry.SSO_REST_CLIENT_SERVICE));
    }

    VcoSession createSamlAuthSession(Authentication auth,
ConnectionConfiguration config) {
         ISamlToken token = auth.getToken();
         RestClient client =
ssoRestClientFactory.credentialPropagatingRestClientByUri(uri, token, config);
         return new VcoSessionOverRestClient(client);
    }
}
```

Solution Authentication Service

Available in version 7.0.0 and later.

The Solution authentication service provides access to the solution user token. The service does not provide a direct access to the token but creates an authentication object that you can use to construct a REST client that can send requests to the vRealize Automation APIs.

You can access the Solution authentication service, no matter if the plug-in is Spring-enabled or not.

3. Access the service.
    a. If the plug-in is Spring-enabled:

```
//Object must be declared in the spring context
public class MyDomainObject {
    @Autowired
    private SolutionAuthenticationService solutionAuthenticationService;

}
```

b. If the plug-in is not Spring-enabled:

```
public class PluginAdaptor implements IServiceRegistryAdaptor {


    private IServiceRegistry registry;
    private SolutionAuthenticationService solutionAuthenticationService;

    @Override
    public void setServiceRegistry(IServiceRegistry registry) {
        this.registry = registry;
    }

    public SolutionAuthenticationService getSolutionAuthenticationService() {
        if (solutionAuthenticationService == null) {
            solutionAuthenticationService = (SolutionAuthenticationService)
registry.getService(IServiceRegistry.SOLUTION_AUTHENTICATION_SERVICE);
        }
        return solutionAuthenticationService;
    }

}
```

Scripting Object Contributor Service

Available in version 7.0.0 and later.

With the Scripting object contributor service, plug-ins can register scripting objects at runtime, without having to restart the Orchestrator server.

FROM ORCHESTRATOR VERSION	SERVICE	DESCRIPTION
7.0.0	ScriptingObjectsContributor	A service endpoint that registers scripting objects at runtime.
7.0.0	ScriptingObjectDefinition	A definition of a scripting object.
7.0.0	ScriptingAttributeDefinition	A definition of an attribute of a scripting object.
7.0.0	ScriptingMethodDefinition	A definition of a method of a scripting object.
7.0.0	ScriptingConstructorDefinition	A definition of a constructor of a scripting object.

1. Access the service.

   a. If the plug-in is Spring-enabled:

```
//Object must be declared in the spring context
public class MyDomainObject {
    @Autowired
    private ScriptingObjectsContributor scriptingObjectContributor;

}
```

b. If the plug-in is not Spring-enabled:

```
public class PluginAdaptor implements IServiceRegistryAdaptor {


    private IServiceRegistry registry;
    private ScriptingObjectsContributor scriptingObjectContributor;

    @Override
    public void setServiceRegistry(IServiceRegistry registry) {
        this.registry = registry;
    }

    public ScriptingObjectsContributor getScriptingObjectContributor() {
        if (scriptingObjectContributor == null) {
            scriptingObjectContributor = (ScriptingObjectsContributor)
registry.getService(IServiceRegistry.SCRIPTING_OBJECTS_CONTRIBUTOR_SERVICE);
        }
        return scriptingObjectContributor;
    }

}
```

2. Contribute a scripting object with a single attribute.

```
//Provided the service is already instantiated

ScriptingObjectsContributor scriptingObjectContributor;


//Init a list of attributes of the scripting object

List<ScriptingAttributeDefinition> attributes = new LinkedList<>();


//Create a single scripting attribute of type string

ScriptingAttributeDefinition attribute =
ScriptingAttributeDefinition.newBuilder()

    .scriptName("scriptingAttributeName") //The attribute will appear with this
name in the orchestrator

    .javaName("scriptingAttributeName") //The attribute name in the
corresponding Java class

    .type("string") //The attribute type

    .description("Description of the attribute") //Description of the attribute

    .build();

attributes.add(attribute);


//Create a scripting object, setting the above created attribute
```

```
ScriptingObjectDefinition object = ScriptingObjectDefinition.newBuilder()

    .scriptingName("scriptingObjectName") //The name of the scripting object as
it will appear in the orchestrator

    .javaClassName(MyClass.class.getName()) //The corresponding java class

    .attributes(attributes) //The above created attributes

    .description(enumeration.getDocumentation()) //Description of the scripting
object

    .dynamic(true)

    .dynamicInvocation(true)

    .build();


//Invoke the service

scriptingObjectContributor.contribute(Collections.singletonList(object));
```

Cipher Service

The Cipher service uses the Orchestrator encryption algorithms to encrypt and decrypt strings. You can use this service when a plug-in stores sensitive data.

1. Access the service.

   a. If the plug-in is Spring-enabled:

```
//Object must be declared in the spring context
public class MyDomainObject {

    @Autowired
    private ICipher cipherService;
}
```

   b. If the plug-in is not Spring-enabled:

```
public class PluginAdaptor implements IServiceRegistryAdaptor {

    private IServiceRegistry registry;
    private ICipher cipherService;

    @Override
    public void setServiceRegistry(IServiceRegistry registry) {
        this.registry = registry;
    }

    public ICipher getCipherService() {
        if (cipherService == null) {
            cipherService =
registry.getService(IServiceRegistry.CIPHER_SERVICE);
        }
        return cipherService;
    }
}
```

2. Invoke the encrypt and decrypt methods.

```
public class MyCustomModelClass {
    private ICipher cipherService;

   //Encrypts a string
    cipherService.encrypt("text-to-encrypt");
    //Decrypt a vRO encrypted string
    cipherService.decrypt("..."); // the string for decryption
}
```

NOTE If the decryption fails, it will fall back to the legacy decryption algorithm that is available in earlier versions of Orchestrator.