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# **SAS<sup>®</sup> Visual Process Orchestration Server 2.1 Administrator's Guide**

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**SAS® Visual Process Orchestration Server 2.1: Administrator's Guide**

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# Accessibility Features

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## Overview

SAS Visual Process Orchestration Server has not been tested for compliance with U.S. Section 508 standards and W3C Web content accessibility guidelines. If you have specific questions about the accessibility of SAS products, send them to [accessibility@sas.com](mailto:accessibility@sas.com) or call SAS Technical Support.

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## Documentation Format

Please contact [accessibility@sas.com](mailto:accessibility@sas.com) if you need this document in an alternative digital format.



# Recommended Reading

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- *SAS Visual Process Orchestration Server User's Guide*
- *SAS Management Console: Guide to Users and Permissions*
- *SAS Intelligence Platform: System Administration Guide*
- *SAS Logging: Configuration and Programming Reference*
- *SAS Intelligence Platform: Middle-Tier Administration Guide*
- *SAS Intelligence Platform: Security Administration Guide*
- *Encryption in SAS*
- *DataFlux Secure Administrator's Guide*
- *DataFlux Data Management Server Administrator's Guide*

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# Chapter 1

## Overview

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### About the Design Server and Runtime Server

The SAS Visual Process Orchestration Server software consists of two servers, the Design Server and the Runtime Server. The two servers are installed on a single host. Together, the two servers manage the development and execution of orchestration jobs.

Orchestration jobs (also known as process jobs) execute an ordered series of component jobs that were previously created in SAS Data Integration Studio or in DataFlux Data Management Studio. The component jobs can execute SAS programs, other programs, scripts, and real-time services. The component jobs run on the servers on which they were deployed, such as DataFlux Data Management Servers. Orchestration jobs can use control logic, events, and parallel processing as needed to coordinate the execution of their component jobs.

You create orchestration jobs in the SAS Visual Process Orchestration Web Client, by dragging and dropping component jobs and coordination nodes into an ordered sequence.

The SAS Visual Process Orchestration Design Server works with the web clients to create, modify, and delete orchestration jobs. The orchestration job files are stored on a SAS Content Server.

The Design Server ensures that each orchestration job can interact with other orchestration jobs and with real-time services that run on DataFlux Data Management Servers. The Design Server can also extract from the job a list of input and output variables. The Design Server extracts variables when the SAS web client add or modifies a node that references another orchestration job or a real-time service.

The SAS Web Application Server ensures that the user of the SAS web client is authorized to access all of the component jobs and data tables that are included in the orchestration job.

The SAS Visual Process Orchestration Runtime Server executes orchestration jobs. When a SAS web client requests a job run, the job is retrieved from the SAS Content Server and executed by the Runtime Server.

For a given orchestration job, the Runtime Server can trigger the execution of other orchestration jobs and remotely stored component jobs and real-time services. These interactions use the input and output variables that are maintained by the Design Server.

During the execution of orchestration jobs, the Runtime Server authenticates the requesting user through the SAS Metadata Server. The SAS Web Application ensures that the web client is authorized to access the component jobs, real-time services, and data sources that comprise the orchestration job.

The Runtime Server sole method of communication is a SOAP interface. The Runtime Server listens at one port for requests to run orchestration jobs.

All orchestration jobs run in separate multi-threaded processes.

The Design Server and Runtime Server are installed together in the SAS Visual Process Orchestration Server directory. The two servers share several configuration files, and each server has its own configuration file.

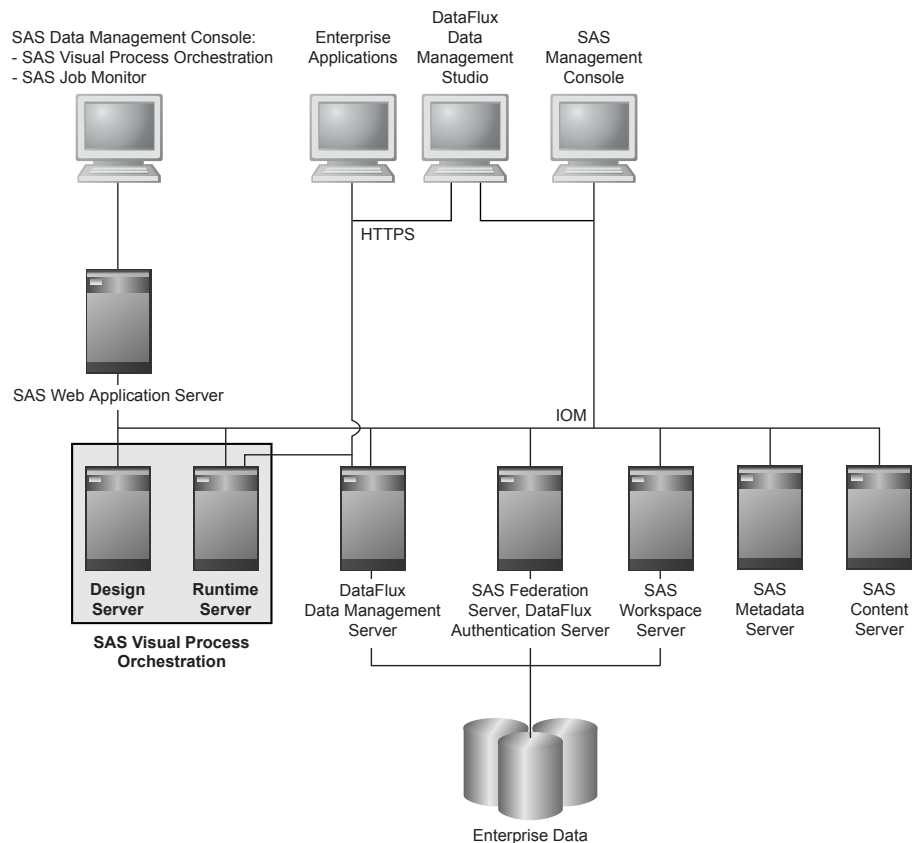
The Design Server encrypts network communication with SAS clients and servers. The Runtime Server can be configured use SSL protection for its SOAP interface. SSL uses encryption, certificates, and HTTPS addresses to protect client connections.

Both the Design Server and Runtime Server can be configured to use any of several upgraded encryption algorithms.

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## System Configuration

The following diagram illustrates the installed configuration of SAS Visual Process Orchestration.



The clients and servers in SAS Visual Process Orchestration are defined as follows:

#### SAS Data Management Console

This graphical client provides access to the SAS Visual Process Orchestration Web Client and other available clients such as the SAS Job Monitor.

#### SAS Visual Process Orchestration Web Client

This web client provides a graphical user interface for the creation, modification, and execution of orchestration jobs.

#### SAS Job Monitor

The SAS Job Monitor displays status information for orchestration job runs. The SAS Job Monitor is provided as part of the SAS Environment Manager. The SAS Job Monitor collects information from specialized log files and processes that information into displays and alerts.

#### SAS Web Application Server

This critical mid-tier server performs a variety of services that enable authentication, authorization, and data source locks on behalf of the SAS Visual Process Orchestration Design Server, Runtime Server, and Web Client.

#### SAS Visual Process Orchestration Design Server

To create, modify, or delete an orchestration job, the SAS web client sends a request to the Design Server port. Listening at that port is a SAS Object Spawner. The Object Spawner assigns an available instance of the Design Server to the SAS web client. If the orchestration job already exists, then the orchestration job is copied from the SAS Content Server. The Design Servers are maintained in a pool. When the SAS web client breaks its connection, the SAS Object Spawner returns the Design Server to the pool for eventual reassignment to another SAS web client.

#### SAS Visual Process Orchestration Runtime Server

The Runtime Server listens for SOAP requests from SAS web clients. When a client requests the execution of an orchestration job, the job is copied from the SAS Content Server. The Runtime Server then passes the job to an available execution process, along with any input variables. The execution process is part of a pool of available execution processes. When the job run is complete, the execution process sends any output variables to the Runtime Server, and the execution service returns to the pool. The Runtime Server sends any output variables to the requesting SAS web client.

#### SAS Metadata Server

The SAS Metadata Server maintains the SAS Metadata Repository and communicates with SAS clients and servers. The repository contains metadata definitions for all of the users, groups, servers, jobs, and data objects that surround the process of job orchestration. The SAS Metadata Server also works with the SAS Web Application Server to authenticate and authorize users, in coordination with network authentication providers.

#### SAS Content Server

The SAS Content Server stores all orchestration jobs. The jobs are retrieved for execution on the host of the Runtime Server.

#### DataFlux Data Management Server

The DataFlux Data Management Server is one type of server that can execute the component jobs and real-time services that are called during the execution of orchestration jobs.

#### DataFlux Data Management Studio

This rich client builds component jobs and real-time services, which are generally stored and executed on DataFlux Data Management Servers.

#### SAS Data Integration Studio

This rich client can provide component jobs and real-time services for orchestration jobs.

#### SAS Management Console

This administrative client provides access to the metadata definitions in the SAS Metadata Repository and enables the control of SAS servers. Administrators can stop and start certain SAS servers and edit server properties that are stored on the SAS Metadata Server.

## Chapter 2

# Configuration

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## Post-Install Configuration

### Configure Metadata

After you deploy SAS Visual Process Orchestration Server, you update the SAS Metadata Repository to accommodate the creation, modification, and execution of orchestration jobs. Use SAS Management Console to add users, groups, roles, capabilities, and access controls.

Default metadata definitions will already exist for the Runtime Server and the Design Server. You can view and edit these server properties in SAS Management Console.

To learn how to add and change metadata, refer to the *SAS Intelligence Platform: System Administration Guide* and to the *SAS Management Console: Guide to Users and Permissions*.

## Enhance Security

You can upgrade from the default encryption algorithm and add SSL protection to the Runtime Server. For more information about upgrading security, see [“Configure Security”](#).

---

## About the Default Configuration

### Default Ports

SAS Visual Process Orchestration uses the following port numbers by default. You can change some of these port numbers using SAS Management Console. Some of these port numbers are not intended to be changed. Contact SAS Technical Support as needed to change port numbers.

| Server   | Port                                    |
|--|---|
| SAS Visual Process Orchestration Design Server                       | 21040                                   |
| SAS Visual Process Orchestration Runtime Server                      | 21050                                   |
| SAS Metadata Server  | 8560                                    |
| SAS Web Infrastructure Data Server Port (SAS Web Application Server) | 5431                                    |
| SAS Web Application Server   | 6969–9648 non-inclusive, as delivered   |
| SAS Object Spawner Operator Port                                     | 8580                                    |
| SAS Object Spawner Port Banks  | 8800–8889                               |
| SAS Content Server HTTP Port   | SAS Web Application Server Default Port |
| SAS Job Monitor Database Server                                      | 9932 - 9941                             |

### Install Path

The Runtime Server is installed in the same directory as the Design Server, on the same host.

The default installation path is specified in this document using the shortened notation **install-path**. This shortened notation enables this document to specify paths that apply to all supported operating environments (Windows, UNIX, and Linux). The subdirectory identifier is specified with a UNIX forward slash for the sake of simplicity. Actual Windows paths use a backslash (\).

Here is the Windows syntax of the `install-path`:

```
SASHome\SASVisualProcessOrchestrationServer\release-number
```

Here is an example of a Windows `install-path`:

```
C:\Program Files\SASHome\SASVisualProcessOrchestrationServer
\2.1
```

The `install-path` syntax for UNIX and Linux is as follows:

```
SASHome/SASVisualProcessOrchestrationServer/release-number
```

A typical `install-path` for UNIX or Linux looks like this:

```
/SASHome/SASVisualProcessOrchestrationServer/2.1
```

## Configuration Files

configuration files Runtime Server configuration files are installed in the directory `install-path/etc`. The operational configuration files are named \*.cfg (app.cfg, dmserver.cfg.) Backup copies of the default configuration files (\*.backup) are stored in the same directory. Retain the backup files for possible future reference to the default configuration.

Several configuration files are shared between the Design Server and Runtime Server. Each of the servers also has its own configuration file. The configuration files are read in a specified sequence when you start the servers,

Most of the options that are set in the configuration files receive values at install time. Most of those values should not be changed unless you are directed to do so by your SAS technical support representative. This document describes how to change the values of supported configuration options as needed at your site.

To change the value of a configuration option of the Runtime Server, stop the server, edit the configuration file, and restart the Runtime Server.

To change the value of a configuration option of the Design Server, stop the SAS Object Spawner, edit the configuration file, and restart the SAS Object Spawner.

The following table describes the configuration files in the order in which they are read during server invocation.

| Configuration Files in Descending Read Order | Description   |
|--|---|
| app.cfg                                      | The Design Server and Runtime Server both read this file at the beginning of the configuration process. The file contains connectivity options.   |
| dmserver.cfg                                 | Read by the Runtime Server only, to specify internal parameters.  |
| dmposerv.cfg                                 | Used by the Design Server only, to specify internal parameters. Currently contains one option that specifies the location of the server log file.   |
| (macros directory)                           | The macros directory (/etc/macros) can contain .cfg files. These files are read by the Design Server and Runtime Server at this point in the invocation process. For more information about macros, see <a href="#">“Define Macros”</a> . |

| Configuration Files in Descending Read Order | Description   |
|--|---|
| macros.cfg                                   | This file can contain substitution values for orchestration jobs. This file is read by both the Design Server and the Runtime Server. |
| (environment variables)                      | The Design Server and Runtime Server read environment values as the last step in the configuration process.                           |

## Directory Permissions

The following tables outline the recommended directory permissions for the Runtime Server.

**Table 2.1** Windows

| Directories             | Users  | Default Permissions                    |
|-------------------------|--|--|
| <i>install-path</i>     | Administrator, Installer                               | Full Control                           |
|                         | Process user   | Read and Execute, List Folder Contents |
| <i>install-path\var</i> | Installer  | Full Control                           |
|                         | Process user   | Read, Write, List Folder Contents      |
|                         | The user who backs up the server, Backup Administrator | Read, List Folder Contents             |

**Table 2.2** UNIX and Linux

| Directories             | Users  | Default Permissions  |
|-------------------------|--|----------------------|
| <i>install-path</i>     | Installer  | Read, Write, Execute |
|                         | Process user   | Read, Execute        |
| <i>install-path/var</i> | Installer  | Read, Write, Execute |
|                         | Process user   | Read, Write, Execute |
|                         | The user who backs up the server; Backup Administrator | Read, Execute        |



*Note:* If the default temporary directory (/TMP) runs out of space while running orchestration jobs, set the TMPDIR environment variable to point to a different directory with greater capacity.

---

## About the Server Invocation Process

This section discusses the invocation processes of the SAS Visual Process Orchestration Design Server and Runtime Server.

The Design Server is invoked by its local SAS Object Spawner, as configured during deployment. The SAS Object Spawner starts, connects to the SAS Metadata Server, and retrieves its own configuration information. The SAS Object Spawner then begins listening on the port that is assigned to the Design Server. When a request arrives for the Design Server from a SAS client, the SAS Object Spawner starts an instance of the Design Server.

When the Runtime Server starts, it retrieves its server properties from the SAS Metadata Server. To contact the SAS Metadata Server, the Runtime Server refers to the configuration option BASE/AUTH\_SERVER\_LOC (in app.cfg). The value of this option is specified during deployment. The value specifies the network name and port of the SAS Metadata Server, as shown in this typical example:

```
base/auth_server_loc=iom://Orion.us.southeast.omr.com:8561
```

To retrieve its server properties, the Runtime Server queries its own metadata definition. To access this definition, the Runtime Server use the value of the configuration option DMSEVER/NAME (in dmserver.cfg). If this option is not defined, then all of the configuration options that would normally be defined in metadata need to be defined in Runtime Server configuration files.

The following table identifies the configuration values that are returned from the SAS Metadata Server. The options that begin with BASE are all optional.

*Note:* The retrieved options that begin with DMSEVER are required. If they cannot be retrieved, or if they are not defined locally, then the Runtime Server does not start.

| Configuration Option              | Description   |
|-----------------------------------|---|
| BASE/<br>APP_CONTAINER_DOM<br>AIN | Specifies the authentication domain that is expected by the application container services.   |
| BASE/<br>AUTH_DEFAULT_DOMA<br>IN  | Specifies a default domain in cases where a user ID applies to multiple logins. To learn how this value is used, refer to the material that follows this table. |
| DMSEVER/SOAP/<br>LISTEN_HOST      | Specifies the port number used by the Runtime Server.   |
| DMSEVER/SOAP/<br>LISTEN_PORT      | Specifies the port number of the SOAP server that is managed by the Runtime Server. The default port number is 21056  |
| DMSEVER/SECURE                    | Specifies that security is enabled or disabled on the Runtime Server.   |

| Configuration Option | Description   |
|----------------------|---|
| DMSERVER/SSL         | Specifies that SSL security is enabled or disabled on the Runtime Server. |

The configuration option `BASE/DEFAULT_AUTH_DOMAIN` contributes to the authentication process as follows:

1. The value of the `BASE/AUTH_DEFAULT_DOMAIN` option is presented for authentication if the value matches the domain of one of the logins that is registered in metadata for the user. If a value is not specified, or no match is found, continue to 2.
2. Use as the domain the value `DefaultAuth`. If the `DefaultAuth` domain matches the domain in one of the user's logins, then it is used as the presented credential authentication domain. If no match is found, continue to 3.
3. Use the first matching login.

---

## Configure Security

### *Authentication and Authorization*

SAS Visual Process Orchestration Server helps authorize and authenticate users as needed throughout the process of creating, modifying, and executing orchestration jobs. Authorization and authentication services are provided by the SAS Web Application Server and the SAS Metadata Server, in coordination with network authentication providers. These services ensure that each orchestration job run request, and each node that is run in those jobs, has appropriate privilege.

Authentication first takes place when users open the SAS web client. The user's credentials are validated by an authentication provider in the domain that is specified in the credentials, or in a default domain. The submitted credentials must match a login for that user that is stored on the SAS Metadata Server.

Authentication also takes place when a user submits a request to run an orchestration job. The requesting user is authenticated by the Runtime Server through the SAS Metadata Server.

Authorization takes place as needed during the creation, modification, and execution of orchestration jobs. The SAS Web Application Server validates the identity of the user of the SAS Web Client and authorizes access to orchestration jobs, data tables, component jobs, and component real-time services.

### *Encryption*

The default security configuration encrypts all credentials that are transmitted using the Integrated Object Model (TCP/IP). Also encrypted are any passwords that need to be stored on disk. The default encryption algorithm is `SASPROPRIETARY`.

## Enhance Security

You can enhance encryption and protect Runtime Server SOAP connections using SSL. To enhance encryption, you change configuration options to specify an encryption algorithm that has a private key length that is greater than SASPROPRIETARY. For the Design Server, you enhance encryption using the SAS/SECURE software, as described in the documents *Encryption in SAS* and *SAS Intelligence Platform: Security Administration Guide*. For the Runtime Server, you install SSL and use its encryption algorithm, as described in the *DataFlux Secure Administrator's Guide*.

SAS/SECURE and DataFlux Secure are installed by default with SAS Visual Process Orchestration Server.

On the Runtime Server, you configure OpenSSL to match the configuration of your SAS web clients. You can use trusted certificates from commercial suppliers, or you can use digitally signed certificates that you generate locally.

As the final step in the process of configuring SSL for the Runtime Server, you update the server's metadata definition on the SAS Metadata Server to indicate that SSL is enabled. This step is important because the Runtime Server retrieves the following option values from the SAS Metadata Server at start time.

| Security Options on the SAS Metadata Server | Description   |
|---|---|
| DMSERVER/SECURE                             | The value YES enables local security, and NO disables local security. |
| DMSERVER/SOAP/SSL                           | The value YES enables SSL, and NO disables SSL.                       |

To change the configuration options in the Runtime Server metadata definition, follow these steps:

1. Start SAS Management Console and enter administrative credentials.
2. Locate the Runtime Server in the server tree. Right-click to display server properties.
3. In the server properties dialog box, click the **Options** tab.
4. In the **Options** tab, change the value of the **Application Protocol** field from **HTTP** to **HTTPS**.
5. Click **OK** to save your change and close the dialog box.

### CAUTION:

**When SSL is configured on the Runtime Server, the server will not start unless it finds the OpenSSL software in the PATH environment variable or in the directory *install-path/bin*. The Runtime Server installation process meets this requirement by default.**

For reference, your SSL configuration needs to include values for the following SSL-related configuration options in `dmserver.cfg`.

| Local SSL Configuration Options        | Description   |
|--|---|
| DMSERVER/<br>SOAP/SSL/KEY_FILE         | Specifies the path to the key file that is required when the SOAP server must authenticate to clients.  |
| DMSERVER/<br>SOAP/SSL/<br>KEY_PASSWD   | Specifies the password for DMSERVER/SOAP/SSL/KEY_FILE. If the key file is not password protected, then comment-out this option. The value of this option must be encrypted. To encrypt passwords, see “Encrypt the Key Password for SSL”. |
| DMSERVER/<br>SOAP/SSL/<br>CA_CERT_FILE | Specifies the file that stores your trusted certificates.   |
| DMSERVER/<br>SOAP/SSL/<br>CA_CERT_PATH | Specifies the path to the directory where you store your trusted certificates.  |

### Encrypt the Key Password for SSL

If your SSL key is password-protected, then you can encrypt a password as described here. You can then add the encrypted password as the value of the Runtime Server configuration option DMSERVER/SOAP/SSL/KEY\_PASSWD (in dmserver.cfg).

To encrypt passwords in the Windows operating environment, run *install-path* \bin\EncryptPassword.exe. Enter the password, confirm your initial entry, and receive the encrypted password.

To encrypt passwords in the UNIX and Linux operating environments, enter the command `dmsadmin crypt`.

---

## Replace the Default Windows Account for the Service

After installation, the SAS Visual Process Orchestration Runtime Server is started using the local system account. Because this account can have access restrictions, you might want to run the service under an administrative account. To maintain security, specify an administrative account only on an as-needed basis.

Follow these steps to specify an administrative account for the Runtime Server:

1. Select **Control Panel** ⇒ **Administrative Tools**.
2. Double-click **Services**, and then select the **Runtime Server** service.
3. Select the **Log On** tab, then select **This account**, and then enter the credentials of the administrative account.

## Runtime Server Configuration Options in dmserver.cfg

The table below lists the configuration options for the SAS Visual Process Orchestration Runtime Server. These options are specified in the file `install-path/etc/dmserver.cfg`. Edit the configuration file to change option values and then restart the server to apply your changes.

The Runtime Server and the Design Server share the configuration options in the `app.cfg` file. To learn about the options in `app.cfg`, see the *Data Management Studio Installation and Configuration Guide*.

To learn how the Design and Runtime Server configuration files are read at server start time, see “[Configuration Files](#)”.

**CAUTION:**

**Do not enable or change the default values of any configuration options in dmserver.cfg that are not defined in the following table.**

| Configuration Option             | Description   |
|----------------------------------|---|
| DMSERVER/<br>JOBS_HISTORY_MAXAGE | <p>Defines a retention period, in seconds, for the history items that are generated by batch and profile job run instances. After the completion of a job, and after the expiration of the specified time period, the Runtime Server purges the job's history from memory. The server also deletes any corresponding log files, statistics files. If the JOBS_KEEP_HISTORY option is enabled, a history record is also deleted from history database.</p> <p>The default value of the MAXAGE option is -1, which specifies that history items are never purged.</p> |
| DMSERVER/JOBS_LOGS_DIR           | <p>Specifies a separate directory for job log for jobs run on this server, other than those that are generated by <code>batch.log.xml</code>. Specifying a separate directory for these log entries can improve performance when you are using the SAS Job Monitor to collect job status information.</p>   |
| DMSERVER/<br>JOBS_KEEP_HISTORY   | <p>A value of YES specifies that the histories of job run instances are retained across server restarts.</p> <p>The default value is NO.</p>  |
| DMSERVER/JOBS_MAX_NUM            | <p>Specifies the maximum number of orchestration jobs that the server runs simultaneously. The default is 25. If a new job request exceeds the limit, the request is placed in a queue.</p>   |

| Configuration Option          | Description   |
|-------------------------------|---|
| DMSERVER/LOG_CHUNK_SIZE       | Controls the size of each log file or statistics file chunk that is sent back to the requesting client. For log files, this option controls the number of characters per chunk. For statistics files, this option controls the number of bytes per chunk. The default value is 512K.  |
| DMSERVER/NAME                 | Specifies the name of the Runtime Server's metadata definition in the SAS Metadata Repository. The server uses the value of this option at start time to retrieve values for configuration options that are critical to the interoperation with the SAS Metadata Server.<br><br>The value of this option is specified during installation. Change this value only if you need to change the name of the Runtime Server in the SAS Metadata Repository.  |
| DMSERVER/NO_WORK_SUBDIRS      | Specifies whether to create log subdirectories for each server run instance. The default value is NO, which specifies that log files are created in separate subdirectories for each server run instance. The subdirectories are located under the default server_logs directory or an alternate directory specified in the <b>DMSERVER/WORK_ROOT_PATH</b> . This option should be set to YES only in special cases, because it puts all log files into the same directory. This makes it difficult to determine which job logs belong to which server run instances and server log files. Each run instance of each process (Runtime Server, DFWFPROC) gets its own, unique log file. Therefore, each new server run instance has to have its own log file, while pre-existing log files, if any, are renamed. |
| DMSERVER/SECURE               | The value YES enables local security, and NO disables local security. The value of this option is maintained in the SAS Metadata Repository. The value is retrieved from the SAS Metadata Server when you invoke the Runtime Server.<br><br><i>Note:</i> Do not specify a value for this option in the local configuration file during normal operation.  |
| DMSERVER/SECURE/<br>GRP_ADMIN | Specifies the name of the Runtime Server administrator group, which must already exist on the SAS Metadata Server before Runtime Server is started. This option is required.  |

| Configuration Option           | Description   |
|--------------------------------|---|
| DMSERVER/SOAP/SSL              | <p>The value YES enables SSL, and NO disables SSL. The value of this option is maintained in the SAS Metadata Repository. The value is retrieved from the SAS Metadata Server when you invoke the Runtime Server.</p> <p><i>Note:</i> Do not specify a value for this option in the local configuration file during normal operation.</p> <p>Set these additional configurations if SSL is configured:</p> <ul style="list-style-type: none"> <li>• DMSERVER/SOAP/SSL/CA_CERT_FILE</li> <li>• DMSERVER/SOAP/SSL/CA_CERT_PATH</li> <li>• DMSERVER/SOAP/SSL/KEY_FILE</li> <li>• DMSERVER/SOAP/SSL/KEY_PASSWD</li> </ul> |
| DMSERVER/SOAP/SSL/CA_CERT_FILE | Specifies the file where the Certificates Authority stores trusted certificates. If this configuration directive is not needed, comment it out.   |
| DMSERVER/SOAP/SSL/CA_CERT_PATH | Specifies the path to the directory where trusted certificates are stored. If this configuration directive is not needed, comment it out.   |
| DMSERVER/SOAP/SSL/KEY_FILE     | Specifies the path to the key file that is required when the SOAP server must authenticate to clients. If this configuration directive is not used, comment it out.   |
| DMSERVER/SOAP/SSL/KEY_PASSWD   | Specifies the password for DMSERVER/SOAP/SSL/KEY_FILE. If the key file is not password protected, this configuration should be commented out.   |
| DMSERVER/THREADS/COUNT_MAX     | Specifies the maximum number of threads that the Runtime Server can start. The default value is 1026 threads. If the setting is too low, it is adjusted automatically. There is no setting for an unlimited number of threads. For optimal performance configure the number of threads based on the expected number of parallel clients and requests.   |
| DMSERVER/THREADS/IDLE_MAX      | Specifies the maximum number of idle threads Runtime Server can keep. The default is 0. If a thread becomes idle, it is terminated. If it is needed again, it is restarted.   |
| DMSERVER/THREADS/IDLE_TIMEOUT  | Specifies the number of microseconds before a thread is flagged as idle after it stops doing work. The default is 0; threads are initially flagged as idle.   |

| Configuration Option    | Description   |
|-------------------------|---|
| DMSERVER/WORK_ROOT_PATH | Specifies the root directory under which Runtime Server work and log subdirectories are created. Each time the server starts, a new work directory is created for that instance of the server. The name of this directory contains the server start-up date and time, as well as the corresponding process ID. The default directory is <code>/var/server_logs</code> . |

---

## Troubleshoot Security Errors

### Overview

Interpret and resolve HTTP security errors as follows for the SAS Visual Process Orchestration Runtime Server.

### 401 Unauthorized

This HTTP error can indicate that the user entered incorrect credentials. The error can also indicate that a user account has not been created on the authorizing server SAS Metadata Server.

### 403 Forbidden

This HTTP error indicates that the user is not authorized to use a particular command or run an orchestration job. Check the job's permissions and the user's roles and capabilities using SAS Management Console.



## Chapter 3

# Administration

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---

## Overview of Server Administration

To administer SAS Visual Process Orchestration, you perform the following tasks:

- Stop, start, and restart the Runtime Server
- Manage membership in the administrator group
- Manage server properties in metadata
- Monitor log files for the Design Server, Runtime Server, and orchestration jobs

SAS Management Console enables you to modify the properties of the Design Server and the Runtime Server and manage membership in the administrator group.

Log files can be generated for the Design Server for each connection to a SAS web client.

Log files can be generated for the Runtime Server for each job run request. Log entries record the results of the orchestration job.

Orchestration job logs can record the results of each component job that is executed in the course of running the orchestration job.

You can configure the SAS Job Monitor to collect and display job status information from the Runtime Server log files. The SAS Job Monitor is part of the SAS Environment Manager.

The SAS Visual Process Orchestration Design Server is started and stopped by its SAS Object Spawner. To stop and start the Runtime Server, see the topics in this chapter.

---

## Start or Stop the Runtime Server on Windows

You can start and stop the Runtime Server using the Microsoft Management Console or by following these steps:

1. Select ⇒ **Start > Control Panel**.
2. Double-click **Administrative Tools** ⇒ **Computer Management**.
3. Expand the **Services and Applications** folder.
4. Click **Services**.
5. Click **SAS Visual Process Orchestration Runtime Server**.
6. Click either **Stop the service** or **Restart the service**.

*Note:* You can also access the Data Management Server service by selecting **Start** ⇒ **All Programs** ⇒ **SAS**.

If the Runtime Server fails to start or restart, see “[Troubleshoot Runtime Server Start](#)”.

---

## Start or Stop the Runtime Server on UNIX or Linux

In the UNIX and Linux operating environments, use the following command to stop or start the Runtime Server:

```
install-path/bin/dmsadmin your-command
```

Here is a typical example:

```
<SASHome>/SASVisualProcessOrchestrationServer/  
2.1/RuntimeServer/bin/dmsadmin start
```

The **dmsadmin** command accepts the following options:

| Command | Description  |
|---------|--|
| start   | Starts the server. For example:<br><code>./bin/dmsadmin start</code> |
| stop    | Stops the server.  |
| status  | Checks whether the server is running.                                |
| help    | Displays Help information.   |
| version | Displays version information.  |

If the Runtime Server fails to start or restart, see [“Troubleshoot Runtime Server Start”](#),

---

## Administer the Server Log Files

When server logging is enabled, a new log subdirectory is created each time you restart the Runtime Server or Design Server. The path to the server log file is *install-path* \var\server\_logs\log-subdirectory.

The log subdirectory can contain the Runtime Server log file dmserver.log and the Design Server log file dmposerver.log.

The following example shows the format of the subdirectory name:

```
20110804-14.26-pid5072__034C24
```

20110804 is the date, 14.26 is the time of the server restart, pid5072 is the process ID, and 034C24 is a unique and random set of characters.

In the Runtime Server log, every orchestration job run request is assigned a unique request identification (RID). Log entries that apply to a given request begin with the RID. Security events do not begin with a RID.

Use the following configuration options in dmserver.cfg to change the location of the Runtime Server log.

| Configuration Option                  | Usage  |
|---------------------------------------|--|
| DMSERVER/WORK_ROOT_PATH = <i>path</i> | The path to the directory where the server creates its working files and subdirectories. To change the destination directory, enter a new path. The default installation path is shown above.                                      |
| DMSERVER/NO_WORK_SUBDIRS = Yes   No   | Controls whether each server run creates a new log subdirectory. The default is NO, which specifies that all log and work files are created in subdirectories. To disable creation of the subdirectories change this value to YES. |

The events and thresholds of the server logs are specified in the files dmserver.log.xml (Runtime Server) and dmposerver.log.xml (Design Server), in *install-path/etc*. To change log events and thresholds, see [“Change Log Events and Thresholds”](#).

---

## Administer Orchestration Job Log Files

Orchestration jobs are executed by DFWFPROC processes, under the direction of the SAS Visual Process Orchestration Runtime Server. When a DFWFPROC process is assigned an orchestration job, it generates a new log file for that particular job run. The name of the job and the name of the job’s log file are added to the Runtime Server log file dmserver.log.

Each new orchestration job log file is stored in a server log subdirectory, as defined in [“Administer the Server Log Files”](#).

The name of a typical log file is illustrated in the following example:

```
18.00.24.125_3727_wfjob_Global_Sales_Summary.log
```

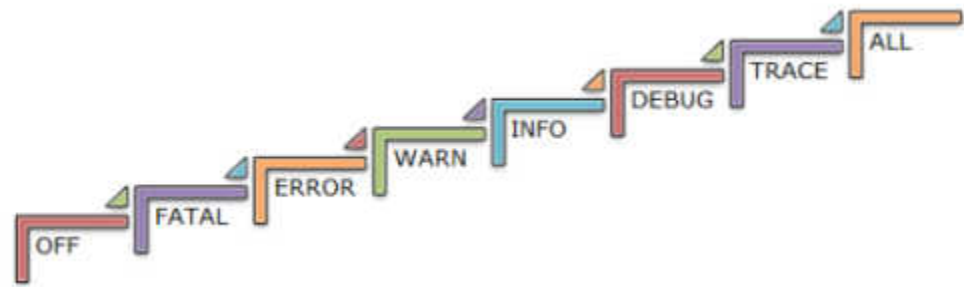
In the preceding example, **18.00.24.125** is a time stamp, **3727** is the server request ID, and **wfjob** is the log file type. The remainder of the name specifies the name of the orchestration job.

The log events and thresholds that are recorded in the orchestration job log are defined by the file `install-path/etc/batch.log.xml`. To change log events and thresholds in `batch.log.xml`, see [“Change Log Events and Thresholds”](#).

## Change Log Events and Thresholds

Loggers and appenders determine the content in the log files of the SAS Visual Process Orchestration Server logs. The loggers and appenders are defined in log configuration files, such as `install-path/etc/dmserver.log.xml`.

Appenders specify the log output destination. Loggers specify log event types and thresholds. If a logger lists a given log event, then those events are recorded in the log file. The threshold value determines the amount of information that is captured in the log file for each event. The available threshold levels are ranked as shown in the following diagram.



The default threshold level capture most of the events that you will need to diagnose server problems. However, should there be a need to increase logging events and threshold levels, contact your SAS technical support representative for assistance.

Altering threshold levels above INFO when the server is operational in a production environment is discouraged since this can result in a reduction in server performance.

When you change a log configuration file, you are required to restart the server.

To learn more about logging, see the *SAS Logging: Configuration and Programming Reference* and the *SAS Interface to Application Response Measurement (ARM): Reference*.

## Change the Encoding of Log Files

If you need to change the encoding of your server job logs and orchestration job logs, set the option `BASE/JOB_LOG_ENCODING` in the file `install-path/etc/app.cfg`. By default, the log is written in the encoding that is associated with the locale of the

process for the executed job. For English-speaking organizations, this might be LATIN-1 or UTF-8.

If a log entry contains characters that cannot be represented in the encoding, then the log entry is not written to the log file.

---

## Troubleshoot Runtime Server Start

### *Port Number Already in Use*

If the Runtime Server fails to start or restart, and if the server log file lists the failure `dfwlpListenAttr_connattr(wlp)`, then another application might be using the server port number. Reassign the server to an unused port number. For more information about default port numbers, see “Default Ports”.

If the server log is not created, then follow these steps if your server installed on Windows:

1. Open the Windows Event Viewer.
2. Select the **Application** event type.
3. Click the **Source** column, to sort the events based on the type of source.
4. Search the Source column for **DataFluxDMS**. Typically, two such events are logged for each time period. If no details are found in those two log events, then look for a log event with the source **SAS**. One such message will include the following message:

```
WARNING: Messages have been logged to
the file named 'C:\Documents and Settings\LocalService\Application
Data\SAS\LOGS\DFINTG-1.EXE.1854.21CBDA9C.log'
```

On UNIX or Linux, errors are written to the stdout location of the shell from which the Runtime Server or Design Server was started.

### *Server Dependency*

If your Runtime Server fails to start or restart, you might need to resolve a server dependency. The SAS Metadata Server must be fully operational before the Runtime Server can start. This dependency reflects the requirement that the Runtime Server retrieves several configuration option values from the SAS Metadata Server at start-up.

To resolve the server dependency, you can use one of the server management applications or commands in your operating environment. In the Windows operating environment, you can execute the following command:

```
sc config "name-of-runtime-service"
depends= "name-of-metadata-service"
```

The services names are provided in the server properties, and they are not the **Display Names**, as shown in the following example:

```
sc config "dfx-POServer-server1"
depends= "SAS [Config-Levl] SASMeta - Metadata Server"
```

In the `sc config` command, the quotation marks are required. Also, the `depends` argument uses no blank space before the equal sign and requires a blank space after the equal sign.

### ***OpenSSL Not Found***

The SAS Visual Process Orchestration Runtime Server does not start if it is configured to use SSL and if OpenSSL is not found. OpenSSL must either be identified in the `PATH` environment variable or stored in the directory `install-path/bin`.

## Chapter 4

# Manage Orchestration Jobs

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---

## Manage the Creation and Modification of Orchestration Jobs

The creation and modification of orchestration jobs is managed by the SAS Visual Process Orchestration Design Server. The Design Server is implemented as a load-balanced server-side pool. This architecture is described in Load Balancing and Pooling chapter of the *SAS Intelligence Platform: Application Server Administration Guide*.

The Design Server consists of a pool of server instances that is managed by an object spawner. The object spawner listens for requests at the Design Server port. When a user opens the SAS Visual Process Orchestration Web Client, the client sends a connection request to the Design Server port. The object spawner responds by receiving authentication and connecting the web client to an available server instance.

When the web client breaks the connection, the server instance is returned to the pool for assignment to another client. If the server instance remains inactive for a specified time period, it is stopped by the object spawner.

To configure the Design Server, set the following options in SAS Management Console. Open the Server Manager and select Properties from the Design Server's context menu.

| Option                           | Default Value       | Description  |
|----------------------------------|---------------------|--|
| Logical Design Server Properties |                     | In SAS Management Console, open the Server Manager and select <b>Properties</b> at the top level of the Design Server. Then select the <b>Load Balancing</b> tab.  |
| <b>Load-balancing algorithm</b>  | Most Recently Used  | Minimizes the number of active server instances.   |
| <b>Availability timeout</b>      | 60 seconds          | Server instance request fails if not assigned within the specified time period.  |
| Design Server Properties         |                     | In SAS Management Console, open the Server Manager and select <b>Properties</b> at the lower level of the Design Server. Then select <b>Options</b> ⇨ ⇨ <b>Advanced Options</b> ⇨ <b>Load Balancing</b> .                      |
| <b>Launch timeout</b>            | 60 seconds          | See Availability timeout.  |
| <b>Recycle activation limit</b>  | 0 connections       | Specifies a number of client connections that are allowed of a given server instance before that instance is recycled (disconnected.)  |
| <b>Service process maximum</b>   | 50 server instances | New client connection requests are refused when the Design Server is running the specified maximum number of server instances. Requests are accepted again when the number of active server instances drops below the maximum. |



| Option                                   | Default Value      | Description   |
|--|--------------------|---|
| <b>Server process minimum</b>            | 0 server instances | The object spawner continues to start new server instances in response to new connection requests from clients, until the minimum value is reached. Above the minimum value, the object spawner seeks to reuse existing server instances in the pool. |
| <b>Inactive process shutdown timeout</b> | 600 seconds        | Specifies the length of time that a server instance can remain inactive before it is terminated by the object spawner.  |

---

## Manage the Execution of Orchestration Jobs

### Overview

The SAS Visual Process Orchestration Runtime Server is implemented as a process pool. At start-up, the Runtime Server parent process starts a specified number of DFWFPROC processes. When the Runtime Server receives a request to run an orchestration job, the server authenticates the requesting user and the job file is retrieved from the SAS Content Server.

When the job is present in memory, the Runtime Server gives the job to an available DFWFPROC process and passes in any input variables. The assigned process runs the orchestration job. During the execution of the orchestration job, the DFWFPROC process authenticates access to individual jobs through the SAS Web Application Server and SAS Metadata Server.

When the orchestration job is complete, the DFWFPROC process passes any output variables to the Runtime Server. The Runtime Server delivers those output variables to the requesting client. The DFWFPROC process is returned to the pool of available processes for eventual assignment to another orchestration job. You can configure the pool of DFWFPROC processes in `dmserver.cfg`, as described in [“Configure Pooling”](#).

If the number of active DFWFPROC processes exceeds the limit that is imposed by `DMSERVER/JOBS_MAX_NUM`, new job run requests are placed in a queue that is transparent to the client. Requests are taken off of the queue and assigned to DFWFPROC processes as those processes become available.

Log events are collected during the execution of each orchestration job. To learn more about logging, see [“Overview of Server Administration”](#).

You can run an orchestration job from the command line and generate a unique log file, as described in [“Run Orchestration Jobs with the `dmpexec` Command”](#)..

### Limit the Number of Jobs

To manage server performance, you can use the configuration option `DMSERVER/MAX_JOB_NUM` to control the number of orchestration jobs that can run simultaneously. When the maximum number of jobs are running, incoming requests to run new orchestration jobs are placed in a queue.

### Resolve Out-of-Memory Errors

Orchestration jobs with a SOAP Request node or an HTTP Request node can run out of memory if you are using a Sun Java Virtual Machine (JVM). If this happens, add the following option to the java start command that is specified in the `app.cfg` file for the server that executes the job.

The Java option is: `-XX:MaxPermSize=256m -XX:+CMSClassUnloadingEnabled`

### Configure Pooling

The SAS Visual Process Orchestration Runtime Server is configured by default to effectively manage a pool of concurrent DFWFPROC processes. You can set configuration options to customize pooling behavior. The configuration options are specified in `install-path/etc/app.cfg`. None of the pooling options are active by default.

To reduce the number of concurrent DFWFPROC processes, you can specify a time value, in seconds, for the option `POOLING/IDLE_TIMEOUT`. This option causes the process pooler to terminate DFWFPROC processes that remain idle beyond the specified time limit. When not specified or when the value is 0, idle processes are not terminated.

You can specify the option `POOLING/MAXIMUM_USE` to specify that DFWFPROC processes are to be terminated after handling a specified number of job runs. When not specified or when the value is 0, there is no limit on the maximum number of job runs.

To control the launch rate of new DFWFPROC processes, you can specify the configuration option `POOLING/CHILD_MAXIMUM_LAUNCHES`. When this option has a value greater than 0, the process pooler simultaneously launches the specified number of processes. If additional processes are required, the process pooler waits until the first set of processes is launched before launching another set of processes. When not specified or when the value is 0, there is no maximum limit to the number of simultaneous process launches.

To specify the maximum length of time that the Runtime Server will wait to receive a DFWFPROC process, set the configuration option `POOLING/GET_PROCESS_TIMEOUT`. The job request fails if a process is not assigned to the job within the specified time period. When not specified or when the value is 0, the client waits indefinitely to receive a process.

To specify a maximum number of failures before a process is terminated, set the configuration option `POOLING/MAXIMUM_ERRORS`. When not specified or when the value is 0, the process is not terminated.

## Run Orchestration Jobs with the `dmpexec` Command

### Overview

You can execute orchestration jobs on the SAS Visual Process Orchestration Runtime Server with the command `install-path/bin/dmpexec`.

### `dmpexec` Options

The `dmpexec` command accepts the following options:

| Option                    | Purpose   |
|---------------------------|---|
| <code>-c filename</code>  | Reads a configuration file to set option values that are specific to the job or command.  |
| <code>-j file</code>      | Executes the job in the specified file.   |
| <code>-l file</code>      | Writes job log messages to a file. Specify different log files for different jobs, and for different runs of the same job, particularly when you are collecting log entries using the Job Monitor application in the SAS Environment Manager. For more information about the Job Monitor, see <a href="#">“Collect Job Status Information in the SAS Job Monitor”</a> . |
| <code>-i key=value</code> | Sets the input variable <code>key</code> to a value before running the job.   |
| <code>-o key=value</code> | Sets a server option to a value.  |
| <code>-b key=value</code> | Sets a job option to a value.   |
| <code>-a</code>           | Authenticates the user who is executing <code>dmpexec</code> . This option is required for domain-enabled connections. To successfully authenticate, you need to specify options that specify the authenticating server, user name, and password.   |

*Note:* You can use the `-i`, `-b`, and `-o` options multiple times to set multiple values.

### Configure Authentication for `dmpexec`

When you specify the `-a` option in the `dmpexec` command, the Runtime Server requires that the following configuration options are set in configuration file `app.cfg`. The recommended method of specifying these options is to add them to a separate file, which you then identify with the `-c` option.

**BASE/AUTH\_SERVER\_LOC=network-path:port** defines how to connect to the SAS Metadata Server.

**BASE/AUTH\_SERVER\_USER=user-name** specifies the user name that will be authenticated by the SAS Metadata Server.

**BASE/AUTH\_SERVER\_PASS=password** specifies the password that is associated with the user name.

### Return Codes for the *dmpexec* Command

The *dmpexec* command returns the following status codes:

| Return Code | Reason                                       |
|-------------|--|
| 0           | Job has finished successfully                |
| 1           | Failure before start of job execution        |
| 2           | Job was canceled                             |
| 3           | Job finished with errors: process terminated |

---

## Collect Job Status Information in the SAS Job Monitor

The SAS Job Monitor is supplied as part of the SAS Environment Manager. You can use the SAS Job Monitor to collect and display job status information. The job status information is collected from the job log files that are generated by the Monitor logger on the SAS Visual Process Orchestration Runtime Server. The Monitor logger is active and configured by default.

To configure the SAS Job Monitor to collect status information for orchestration jobs, see the Help in the SAS Job Monitor.

To enhance the performance of the SAS Job Monitor, and to more easily locate Monitor events, specify a directory for the configuration option `DMSERVER/JOBS_LOGS_DIR` (`dmserver.cfg`) and restart the Runtime Server. Similarly, when you run orchestration jobs with *dmpexec*, specify a log directory with the `-l` option.

When you run an orchestration job, log entries are collected by default at the end of the job run. To collect log entries at specified intervals during the job run, add the configuration option `BASE/MONITOR_FREQUENCY` to the file `install-path/etc/app.cfg`. The value of the option specifies the time interval, in milliseconds, between Job Monitor log entries. The default value `-1` indicates that one Job Monitor log entry is collected at the end of the job run. To collect useful log entries during the job run, experiment with different time-interval option values. Also be aware that a high frequency of log events affects job performance.

To summarize, the requirements for collecting job statistics are defined as follows:

- Install and configure SAS Environment Manager and SAS Job Monitor.

- Create a separate directory for job logs. If you run jobs with **dmpexec**, make sure that you specify a different log file for each run of each job. To maximize performance, generate log events during job execution only during job testing.
- To collect log entries during the job run, add the option `BASE/MONITOR_FREQUENCY` to the `app.cfg` file and restart the Runtime Server.

---

## Define Macros

### Overview

The configuration file `install-path/etc/macros.cfg` defines macro values for substitution into orchestration jobs, and overrides predefined values. Each line in the file represents a macro value in the form `KEY = VALUE`, where the `KEY` is the macro name and `VALUE` is its value, as shown in the following examples.

On a Windows host:

```
INPUT_FILE_PATH = C:\files\inputfile.txt
```

On a UNIX or Linux host:

```
INPUT_FILE_PATH = /home/dfuser/files/inputfile.txt
```

The examples above set the macro value `INPUT_FILE_PATH` to the specified path. This macro is useful when you are porting orchestration jobs from one machine to another, because the paths to an input file in different platforms might not be the same. By using a macro to define the input filename, you do not need to change the path to the file in the orchestration job after you port the job to UNIX. Add the macro in both the Windows and UNIX versions of the `macros.cfg` file, and set the path appropriately in each.

The `etc` directory contains the `macros.cfg` file and a `macros` subdirectory. The `macros` subdirectory can contain `.cfg` files. If one or more `.cfg` files exist in that subdirectory, then they will be read in alphabetical order before the `macros.cfg` file is read. The last value read becomes the value that is applied.

If your jobs use system and user-created macros, you must create a combined macro file to be able to use the macros in the SAS Visual Process Orchestration Runtime Server. For more information about macros, see the online Help for DataFlux Data Management Studio.

### Update Macros

For each orchestration job run, the assigned `DFWFPROC` process reads the configured macros at the beginning of execution.

When a macro changes, follow these steps to update the macro on the server without having to restart the server, using one of the following procedures.

1. In the SAS Visual Process Orchestration Web Client, select the Runtime Server by name.
2. Right-click on the server name and select **Unload idle processes** from the drop-down menu.

Unloading idle processes also updates macros for all subsequent instances of the DFWFPROC process.

---

## Troubleshoot Orchestration Jobs

### Overview

If your job or service experiences any of the following symptoms, refer to the following resolutions.

### ***DFWFPROC processes fail to start, or out of Memory error in Windows when launching server processes***

The Runtime Server log file `dmserver.log` displays the following error message:

```
The application failed to initialize
properly (0xc0000142). Click OK to terminate the
application.
```

The Runtime Server log file might also display one of the following messages:

```
Data Service error: failed to start
service process: 1 - Child failed to
contact server process. Failed to start
base services, rc=1 (Error loading
dependency library).
```

```
Process Service error: Failed to
getprocess, errorCode=2 (Process
'HOST:ADDR' exited unexpectedly.)
```

```
Batch Job error: failed to get process;
err: 0 - Process 'HOST:ADDR' exited unexpectedly.
```

It is possible that the Windows event log does not contain entries for DFWFPROC, and one of the preceding errors appears in the Runtime Server log. In that case, then the error is likely caused by a large number of Windows processes running on the host. The number of processes can prevent Windows from opening new DFWFPROC processes for the Runtime Server. This behavior occurs when Windows runs out of desktop heap. Specifically, the desktop heap in the WIN32 subsystem can be depleted. To free system resources, stop as many non-essential applications and processes as permissible and try to run the jobs again on the Runtime Server. If the errors persist, you might need to make a minor change in the Windows registry. Increase the `SharedSection` parameter of the `SubSystems` key in `HKEY_LOCAL_MACHINE`, as recommended in the following Microsoft Support articles:

- ["Out of Memory" error message appears when you have a large number of programs running](#)
- [User32.dll or Kernel32.dll fails to initialize](#)
- [Unexpected behavior occurs when you run many processes on a computer running SQL Server](#)

**Required OpenSSL not found**

This error message indicates that security is enabled on the Runtime Server and that OpenSSL was not found. The OpenSSL directories either need to be located in the /bin directory or listed in the PATH environment variable. To resolve this error, add the directories to /bin or update the PATH variable and restart the server.

**SQL lookup job fails on a UNIX or Linux system using the Driver for BASE**

The Driver for BASE does not allow data sets to be created that cannot be read by SAS. If you have Driver for SAS files that contain mixed case or uppercase letters that cannot be accessed in UNIX or Linux, then rename the file to all lowercase letters. Other files that contain mixed case or uppercase letters might also need to be renamed using lowercase letters. Once the files are renamed, they can then be accessed in jobs using any case. For example, the file might be named lookupsorce. In jobs, you can reference LOOKUPSOURCE, lookupsorce, or LookUPSoUrCe, just to name a few.

**When opening a job log: SOAP-ENV:Client:UNKNOWN error (or Time-out)**

This error occurs on some configurations of Microsoft Windows Server 2003, when the log file exceeds 32KB. A workaround for this problem is to set the following configuration value in the dmserver.cfg file:

```
DMSERVER/LOG_CHUNK_SIZE = 32KB
```

This error and this resolution apply only to Windows Server 2003.





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