Guide to Microsoft System Center Management Pack for SQL Server Replication

Published in December 2020 by Microsoft Corporation.

This guide is based on version 7.0.28.0 RTM of the Management Pack for Microsoft SQL Server Replication

The Operations Manager team encourages you to provide feedback on the management pack by sending it to sqlmpsfeedback@microsoft.com.

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Changes History

December 2020 - 7.0.28.0 RTM

- **What's New**

    - Updated MP to support SQL Server 2012 through 2019
    - Updated "Replication Agents failed on the Distributor" unit monitor to extend it for Log Reader and Queue Reader agents detection
    - Added new property 'DiskFreeSpace' for "Publication Snapshot Available Space" unit monitor
    - Removed "One or more of the Replication Agents are retrying on the Distributor" monitor as non-useful
    - Removed “Availability of the Distribution database from a Subscriber” monitor as deprecated
    - Updated display strings

- **Bug Fixes**

    - Fixed discovery issue on SQL Server 2019
    - Fixed issue with the incorrect definition of 'MachineName' property of DB Engine in some discoveries and replication agent-state unit monitors
    - Fixed issue with wrong property-bag key initialization on case-sensitive DB Engine in some unit monitors and performance rules
    - Fixed issue with the critical state of "Replication Log Reader Agent State for the Distributor" and "Replication Queue Reader Agent State for Distributor" unit monitors
    - Fixed wrong space calculation in "Publication Snapshot Available Space"
    - Fixed duplication of securable detection for monitor "Subscriber Securables Configuration Status"
    - Fixed issue with the incorrect definition of 'InstanceName' property in "Replication Database Health" discovery
    - Fixed issue with an incorrect alert message for monitor "Pending Commands on Distributor"
    - Fixed issue with incorrect condition detection for monitor "Total daily execution time of the Replication Agent"

April 2019 - 7.0.15.0 RTM

- Supported last changes in version-agnostic management pack for SQL Server.

November 2017 - 7.0.0.0 RTM

- Introduced a number of improvements and bug fixes.

October 2017 - 6.7.65.0 RC1

- The management pack was reimplemented in order to enable monitoring of SQL Server 2017 and all upcoming SQL Server versions.
- Reduced the number of files in the management pack.
- Introduced a number of fixes and improvements to functionality, performance, and display strings.

June 2017 - 6.7.60.0 RC0

- Added a number of monitors and performance rules to create the same Health model as presented in SQL Server 2008-2016 Replication management packs.
- Improved and refactored the management pack modules.
- Fixed a number of issues.

April 2017 - 6.7.40.0 CTP1

- Original release of this management pack.

Management Pack Scope and Supported Configurations

Management Pack for SQL Server Replication is version-agnostic, which means that it supports discovery and monitoring of SQL Server 2012 through 2019 and higher.

System Center Operations Manager Configurations

The management pack is designed for the following versions of System Center Operations Manager:

- System Center Operations Manager 2012 R2
- System Center Operations Manager 2016
- System Center Operations Manager 1801
- System Center Operations Manager 1807
- System Center Operations Manager 2019

A dedicated Operations Manager management group is not required for this management pack.

Operating Systems and Platforms

Management Pack for SQL Server Replication supports the following 64-bit operating systems and platforms:

- Windows Server 2012
- Windows Server 2012 R2
- Windows Server 2016
- Windows Server 2019

Agentless Monitoring

Management Pack for SQL Server Replication supports agentless monitoring mode that allows monitoring of SQL on Windows.

In this mode, the management pack workflows run on management servers and gateway servers that are mapped to *SQL Server Monitoring Pool* or *All Management Servers Pool* if the former is not configured.

SQL Server Features

Management Pack for SQL Server Replication works with any Express or Enterprise edition of SQL Server 2012 up to SQL Server 2019 and higher.

All SQL Server Express editions support Replication as Subscriber with Push subscriptions only. For more informarion, see Editions and supported features of SQL Server.

The management pack supports the following features and configurations of 64-bit SQL Server Database Engine:

- Distributor
    - Log Reader Agent metrics
    - Snapshot Agent metrics

    - Queue Reader Agent metrics
    - Merge Agent metrics
    - Job metrics
    - Delivery metrics
    - Space metrics
- Publisher
- Publication
    - Database Availability metrics
    - Database Configuration metrics
    - Database Performance metrics
- Subscriber
    - Job metrics
    - Performance metrics
- Subscription (Push/Pull)
    - Database Availability metrics
    - Database Configuration metrics
    - Database Performance metrics

Prerequisites

- **.NET Framework 4.5+**

  Installation of .NET Framework 4.5 or higher is required

- **Management Pack for Windows Server Operating System**

  As a best practice, you should import the Windows or Linux Server Management Pack for the operating system you are using. The management packs monitor aspects of the operating system that influence the performance of computers running SQL Server, such as disk capacity, disk performance, memory utilization, network adapter utilization and processor performance.

- **Management Pack for SQL Server**

  Management Pack for SQL Server is required to work with Management Pack for SQL Server Replication.

- **Health Service Agent Proxy**

  Enable the *Agent Proxy* option for all agents that use this management pack to monitor SQL Server.

  The *Agent Proxy* option allows an agent to forward data to the management server on behalf of another entity. This option should be enabled if agent workflow scenarios discover any non-hosted objects (non-hosted objects are created for each SQL Server instance).

  For more information on how to configure a proxy agent, see Enabling Agent Proxy Option

Management Pack Delivery

You can download Management Pack for SQL Server Replication from the Microsoft portal or find it in the System Center Operations Manager Online Catalog.

The package includes the following files:

- **Microsoft.SQLServer.Windows.Replication.ManagementPack.msi**

  A set of .MP and .MPB files for monitoring of SQL Server Replication on Windows.

- **SQLServerDashboardsGuide.pdf**

  The User Guide for SQL MP Dashboards.

- **SQLServerReplicationMPGuide.pdf**

  This User Guide.

Management Pack for SQL Server Replication consists of the following files:

- **Microsoft.SQLServer.Replication.Windows.Discovery.mpb**

  This management pack discovers Microsoft SQL Server Replication Instances.

- **Microsoft.SQLServer.Replication.Windows.Monitoring.mpb**

  This Management Pack enables monitoring of Microsoft SQL Server Replication and depends on the Microsoft SQL Server Replication (Discovery) Management Pack.

- **Microsoft.SQLServer.Replication.Windows.Views.mp**

  This Management Pack contains views and folder structure for Microsoft SQL Server Replication management packs.

- **Microsoft.SQLServer.Replication.Core.Library.mpb**

  This Management Pack is the core library for all versions of SQL Server Replication. It defines all SQL Server Replication base classes and relationships.

- **Microsoft.SQLServer.Replication.Core.Views.mpb**

  This Management Pack is the core library views for all versions of SQL Replication.

- **Microsoft.SQLServer.Visualization.Library.mpb**

  This Management Pack contains basic visual components required for SQL Server dashboards.

Terms and Definitions

- **Distributor**

  Distributor is a database instance that acts as a store for replication specific data associated with one or more Publishers. Each Publisher is associated with a single database (known as a distribution database) at the Distributor. In many cases, a single database server instance acts as both Publisher and Distributor. This is known as a local Distributor. When Publisher and Distributor are configured on separate database server instances, the Distributor is known as a remote Distributor.

- **Distribution database**

Distribution database stores replication status data, metadata about the publication, and, in some cases, acts as a queue for data moving from Publisher to Subscribers. In many cases, a single database server instance acts as both Publisher and Distributor. This is known as a local Distributor. When Publisher and Distributor are configured on separate database server instances, the Distributor is known as a remote Distributor.

- **Publisher**

  Publisher is a database instance that makes data available to other locations through replication. A Publisher can have one or more publications, each defining a logically related set of objects and data to replicate.

- **Publication**

  Publication is a collection of one or more articles from one database. Such grouping of multiple articles into a publication makes it easier to specify a logically related set of data and database objects that are replicated as a unit. A publication can contain different types of articles, including tables, views, stored procedures, and other objects. When tables are published as articles, filters can be used to restrict the columns and rows of the data sent to Subscribers.

- **Article**

  Article identifies a database object that is included in a publication.

- **Subscriber**

  Subscriber is a database instance that receives replicated data. A Subscriber can receive data from multiple Publishers and publications. Depending on the selected replication type, a Subscriber can also pass data changes back to the Publisher, or republish the data to other Subscribers.

- **Subscription**

  Subscription is a request for a copy of a publication to be delivered to a Subscriber. A subscription defines what publication will be received, where and when. There are two types of subscriptions: push and pull.

- **Push subscription**

  Push subscription is represented by a subscription created and administered at the Publisher. The distribution agent or merge agent for this subscription runs at the Distributor. For more information about subscriptions, see Subscribe to Publications.

- **Pull Subscription**

  Pull subscription is represented by a subscription configured and maintained at each recipient. The subscribers administer the synchronization schedules and can pull changes whether they consider it necessary. For more information about subscriptions, see Subscribe to Publications.

- **Virtual Distributor**

  Virtual Distributor is a virtual entity, which serves to represent a real distributor on the diagram view for a Replication Database Health.

- **Virtual Publisher**

  Virtual Publisher is a virtual entity serves to represent a real publisher on the diagram view for a Replication Database Health.

- **Virtual Subscriber Host**

  Virtual Subscriber Host is a virtual entity that contains Virtual Subscribers.

- **Virtual Subscriber**

  Virtual Subscriber is a virtual entity serves to represent a real Subscriber on the diagram view for a Replication Database Health.

- **Virtual Publication Host**

  Virtual Publication Host is a virtual entity that contains Publications.

- **Publication database**

  Publication database is the database on the Publisher that is the source of data and database objects to be replicated.

- **Virtual Subscription**

  Virtual Subscription is a virtual entity serves to represent a real subscription on the diagram view for a Replication Database Health. The purpose of this entity is to hide all subscriptions when the diagram is opened for the first time.

Monitoring Scenarios

Discovery of SQL Server Replication Objects

Management Pack for SQL Server Replication enables discovery and monitoring of all SQL Server Replication related components.

The management pack supports agent, agentless and mixed monitoring types; it automatically selects the monitoring type used by the management pack for SQL Server to monitor the appropriate SQL Server instance.

Replication objects discovered and monitored by the management pack are as follows:

- Distributor
- Publisher
- Subscriber
- Publication
- Subscription

Each managed replication object is discovered and monitored using a number of rules and monitors.

Many Publication Snapshots on the Same Drive

Space monitoring introduced in this management pack may be noisy in environments where many publication snapshots share the same media. In such cases, an alert for a publication snapshot is generated when the amount of free space on the hard drive reaches the threshold.

To reduce the noise, turn off space monitors for *Snapshot Available Space (%)* and use Operating System Management Pack to monitor space on the hard drive.

Maintenance Job Failure

Replication uses maintenance jobs that are monitored by *MSSQL Replication: The Maintenance Job(s) Failed on Distributor Alert Rule*:

- Reinitialize subscriptions having data validation failures
- Agent history clean up: distribution
- Replication monitoring refresher for distribution.
- Replication agents checkup
- Distribution clean up: distribution
- Expired subscription clean up

For more information, see Run Replication Maintenance Jobs (SQL Server Management Studio)

Job Failure

Management Pack for Microsoft SQL Server Replication defines a monitor targeted at the Distributor and Subscriber. These monitors oversee the replication agent jobs and change the monitor state when the job has the following states:

- Job Exist But Never Run and Has Not Scheduled
- Job Expired
- Job Failed
- Job is Disabled
- Job is Enabled but Schedule is Disabled
- Job Execution Failed and was Not in Accordance with the Schedule
- Job is Retry
- Job Never Run
- Job Never Run But Schedule Exist
- Job Successfully Done But Not in Accordance with the Schedule
- Job Execution was Stopped and was Not in Accordance with the Schedule
- Previous Job Execution Failed
- Previous Job Execution was Stopped
- Unknown State of the Job

Distributor Securables Configuration Status Monitor

This monitor checks if each of the required Replication Distributor securables is accessible under the configured Run As account.

The following is a complete list of securables that are checked by the monitor targeted to the Replication Distributor:

- Server-Level permissions
    - VIEW SERVER STATE
    - VIEW ANY DATABASE
- SELECT permission on catalog views
    - sys.servers
    - sys.configurations
    - msdb.dbo.sysjobs
    - msdb.dbo.sysjobhistory
    - msdb.dbo.sysjobschedules
    - msdb.dbo.sysschedules
    - msdb.dbo.syscategories
    - msdb.dbo.sysjobservers
- EXECUTE permission on stored procedures
    - sp_MSget_repl_commands
    - xp_sqlagent_enum_jobs

Publisher Securables Configuration Status Monitor

This monitor checks if each of the required Replication Publisher securables is accessible under the configured Run As account.

The following is a complete list of securables that are checked by the monitor targeted to the Replication Publisher:

- Server-Level permissions
    - VIEW SERVER STATE
    - VIEW ANY DATABASE
- EXECUTE permission on stored procedures
    - sp_helppublication
    - sp_helpmergepublication
    - sp_helpdistributor

Subscriber Securables Configuration Status Monitor

This monitor checks if each of the required Replication Subscriber securables is accessible under the configured Run As account.

The following is a complete list of securables that are checked by the monitor targeted to the Replication Subscriber:

- Server-Level permissions
    - VIEW SERVER STATE
    - VIEW ANY DATABASE

- SELECT permission on catalog views
    - sys.configurations
    - msdb.dbo.sysjobs
    - msdb.dbo.sysjobhistory
    - msdb.dbo.sysjobschedules
    - msdb.dbo.sysschedules
    - msdb.dbo.sysjobservers
- EXECUTE permission on stored procedures
    - sp_MSenumsubscriptions
    - sp_helppullsubscription
    - sp_helpmergepullsubscription
    - xp_sqlagent_enum_jobs
    - sp_MSget_repl_commands

Security Configuration

This section explains how to configure security for Management Pack for Microsoft SQL Server Replication.

Run As Profiles

Management Pack for Microsoft SQL Server Replication uses the same Run As profiles as Microsoft System Center Management Pack for SQL Server. For more information about Run As profiles, see the Microsoft System Center Management Pack for SQL Server guide.

Mind that the use of Service Security Identifier (SID) or Local System account as the Run As account is not supported in this management pack.

Low-Privilege Agent Monitoring

To configure low-privilege monitoring, in addition to the steps described in the **Low-Privilege Agent Monitoring** section of the Management Pack for SQL Server User Guide, perform the following provisioning steps on an agent machine:

1. Open SQL Server Management Studio and connect to the instance of SQL Server Database Engine that participates in Replication.
2. Create the *SQLMPLowPriv* user in each user database and *master*, *msdb* and *model* databases.
3. Grant the *SQLMPLowPriv* user the following permissions on both the **Distributor** and the **Publisher** SQL Server Replication roles:

```
USE [msdb]
GO
GRANT SELECT ON [dbo].[MSdistpublishers] TO [SQLMPLowPriv]
GRANT EXECUTE ON [dbo].[agent_datetime] TO [SQLMPLowPriv]
```

4. Grant the *SQLMPLowPriv* user the following permissions on the **Subscriber** SQL Server Replication role:

```
USE [msdb]
GO
GRANT EXECUTE ON [dbo].[agent_datetime] TO [SQLMPLowPriv]
```

5. In SQL Server Management Studio, add the *SQLMPLowPriv* user to the *db_owner* database role for each **distribution** database on the **Distributor** SQL Server Replication role. In cases of multiple distributor databases, this permission should be granted to each database:

```
USE [distribution]
GO
ALTER ROLE [db_owner] ADD MEMBER [SQLMPLowPriv]
```

6. In SQL Server Management Studio, add the *SQLMPLowPriv* user to the *db_owner* database role for each database that participates in **publication** on the **Publisher** SQL Server Replication role. In cases of multiple publication databases, this permission should be granted to each database:

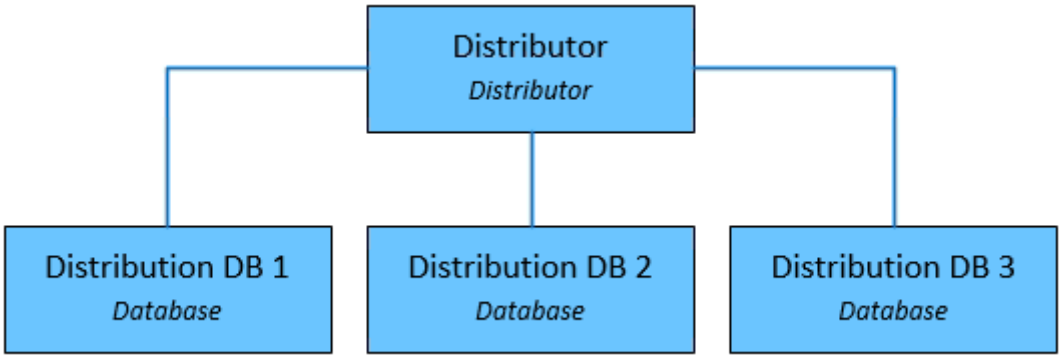
```
/*Run this query on databases that participate in Publication.
Replace the 'DatabaseName' parameter with the value that you want to use.*/
USE [DatabaseName]
GO
ALTER ROLE [db_owner] ADD MEMBER [SQLMPLowPriv]
```

7. In SQL Server Management Studio, add the *SQLMPLowPriv* user to the *db_owner* database role for each database that participates in **subscription** on the **Subscriber** SQL Server Replication role. In cases of multiple subscription databases, this permission should be granted to each database:

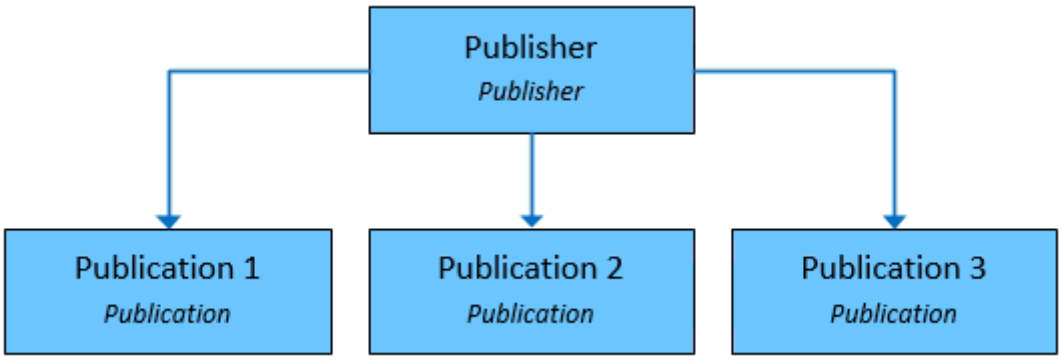
```
/*Run this query on databases that participate in Subscription.
Replace the 'DatabaseName' parameter with the value that you want to use.*/
USE [DatabaseName]
GO
ALTER ROLE [db_owner] ADD MEMBER [SQLMPLowPriv]
```

Data Flow

Logical Structure



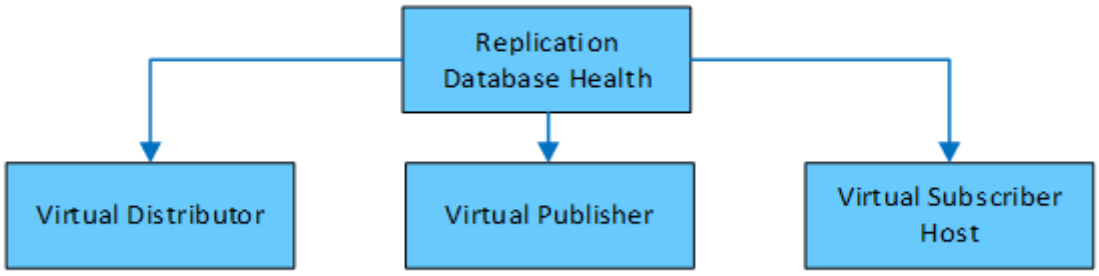
Publication Flow



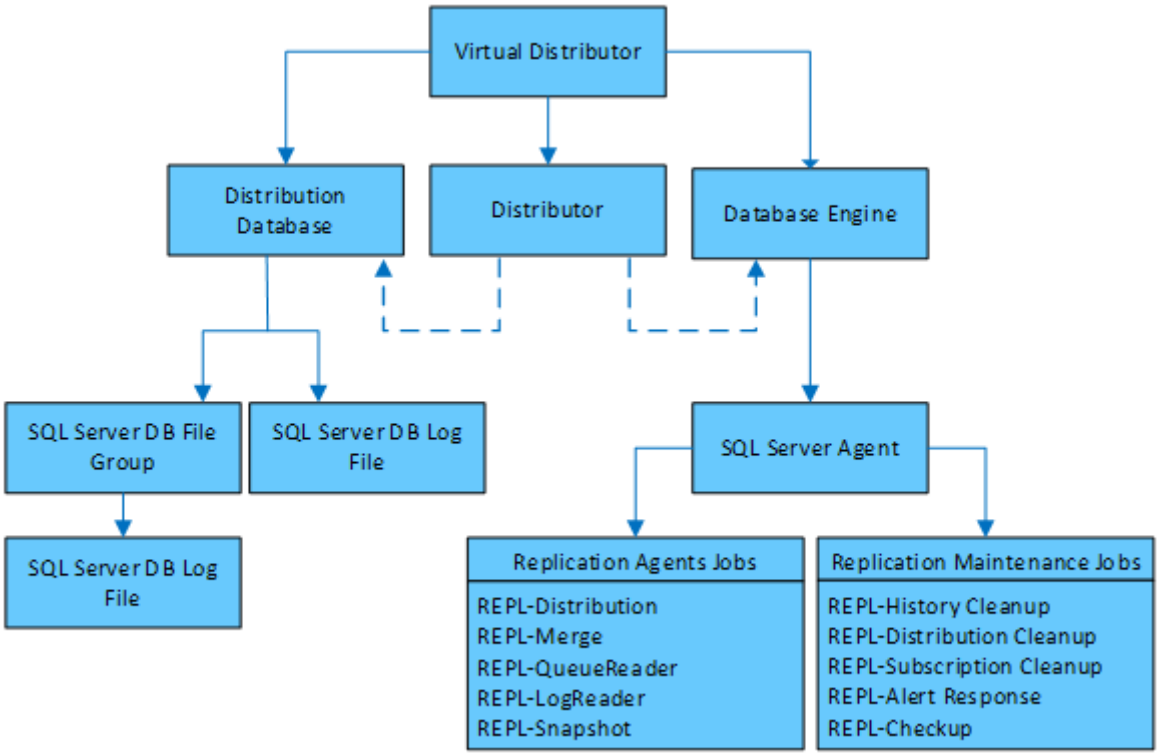
Replication Database Health

Replication Database Health is built for databases participating in the replication process as the published database.

Top-Level Structure



Virtual Distributor Level Structure



Replication agent files are located in the '\Program Files\Microsoft SQL Server\100\COM' directory.

The following table lists replication executable names and file names.

Agent Executable	File Name
Replication Snapshot Agent	snapshot.exe
Replication Distribution Agent	distrib.exe
Replication Log Reader Agent	logread.exe
Replication Queue Reader Agent	qrdrsvc.exe
Replication Merge Agent	replmerg.exe

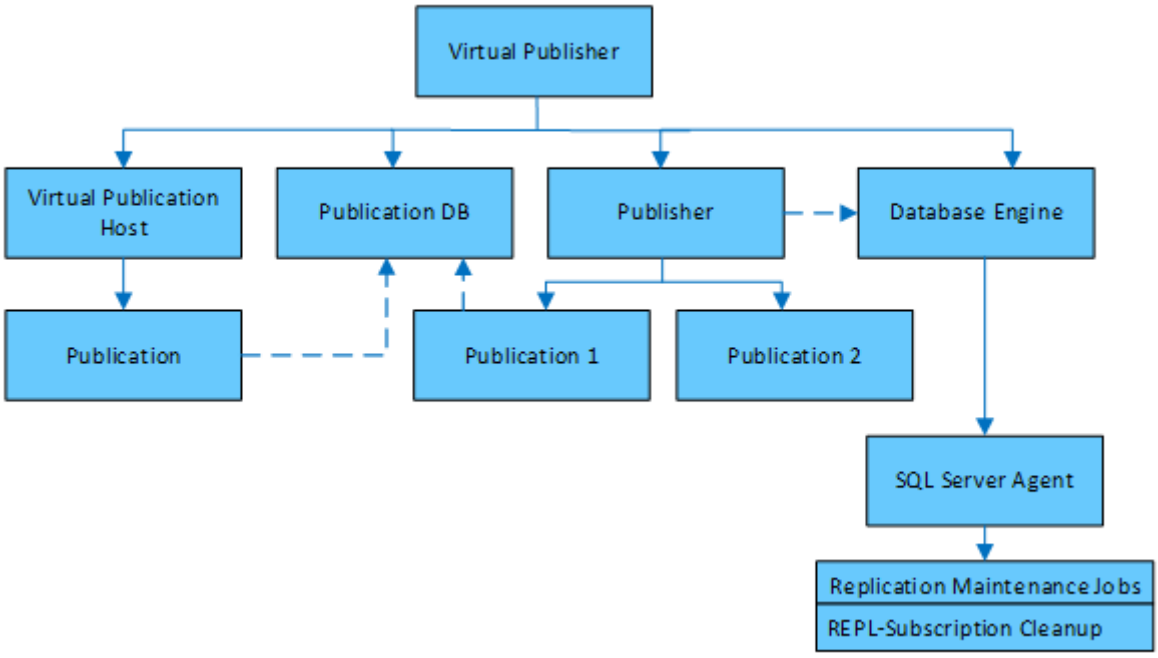
In addition to replication agents, replication has a number of jobs that perform scheduled and on-demand maintenance operations.

Replication Maintenance Jobs

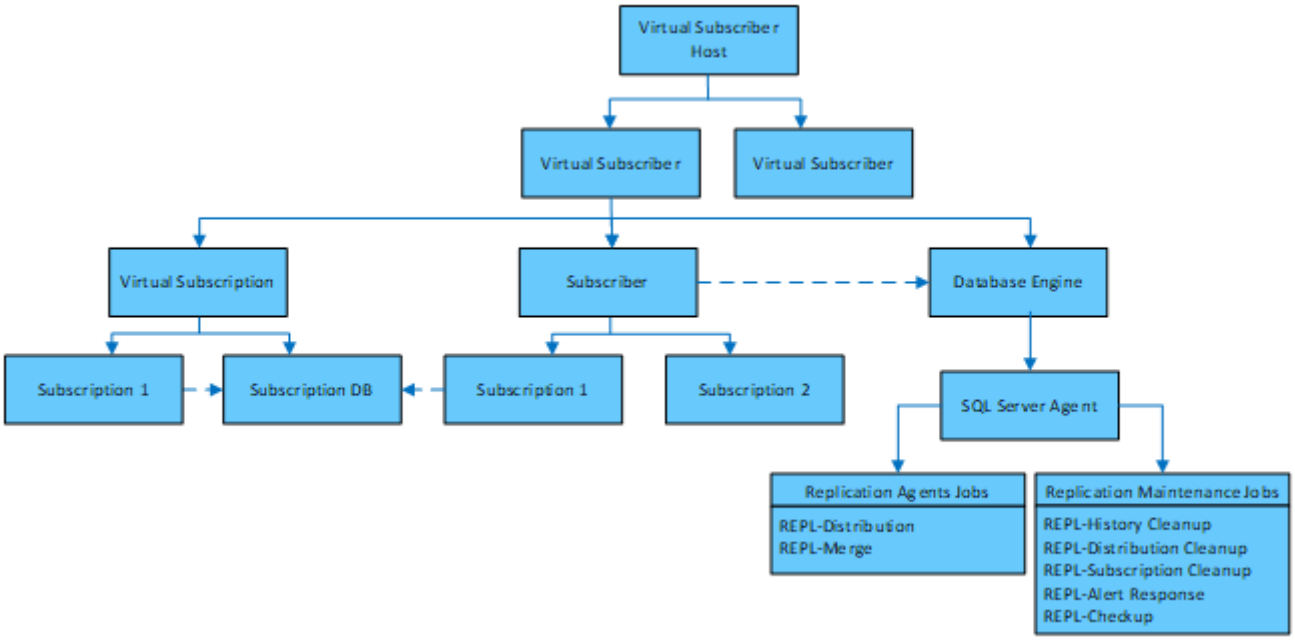
Clean up job	Description	Default schedule
Agent History Clean Up: Distribution	Removes replication agent history from the distribution database.	Runs every ten minutes
Distribution Clean Up: Distribution	Removes replicated transactions from the distribution database. Deactivates subscriptions that have not been synchronized within the maximum distribution retention period.	Runs every ten minutes

Clean up job	Description	Default schedule
Expired Subscription Clean Up	Detects and removes expired subscriptions from publication databases.	Runs every day at 1:00 A.M.
Reinitialize Subscriptions Having Data Validation Failures	Detects all subscriptions that have data validation failures and marks them for re-initialization. The next time the Merge Agent or Distribution Agent runs, a new snapshot will be applied at the Subscribers.	No default schedule (not enabled by default).
Replication Agents Checkup	Detects replication agents that are not actively logging history. It writes to the Microsoft Windows event log if a job step fails.	Runs every ten minutes.
Replication monitoring refresher for distribution	Refreshes cached queries used by Replication Monitor.	Runs continuously.

Virtual Publisher Level Structure



Virtual Subscriber Level Structure



Configuring Management Pack

This section explains how to configure Management Pack for Microsoft SQL Server Replication.

Best Practice: Create Management Pack for Customizations

Management Pack for Microsoft SQL Server Replication is sealed, which means that you cannot change any of the original settings.

In cases when you need to change original settings, you can create a custom management pack to keep overrides and new monitoring objects.

Creating a custom management pack for storing overrides has the following advantages:

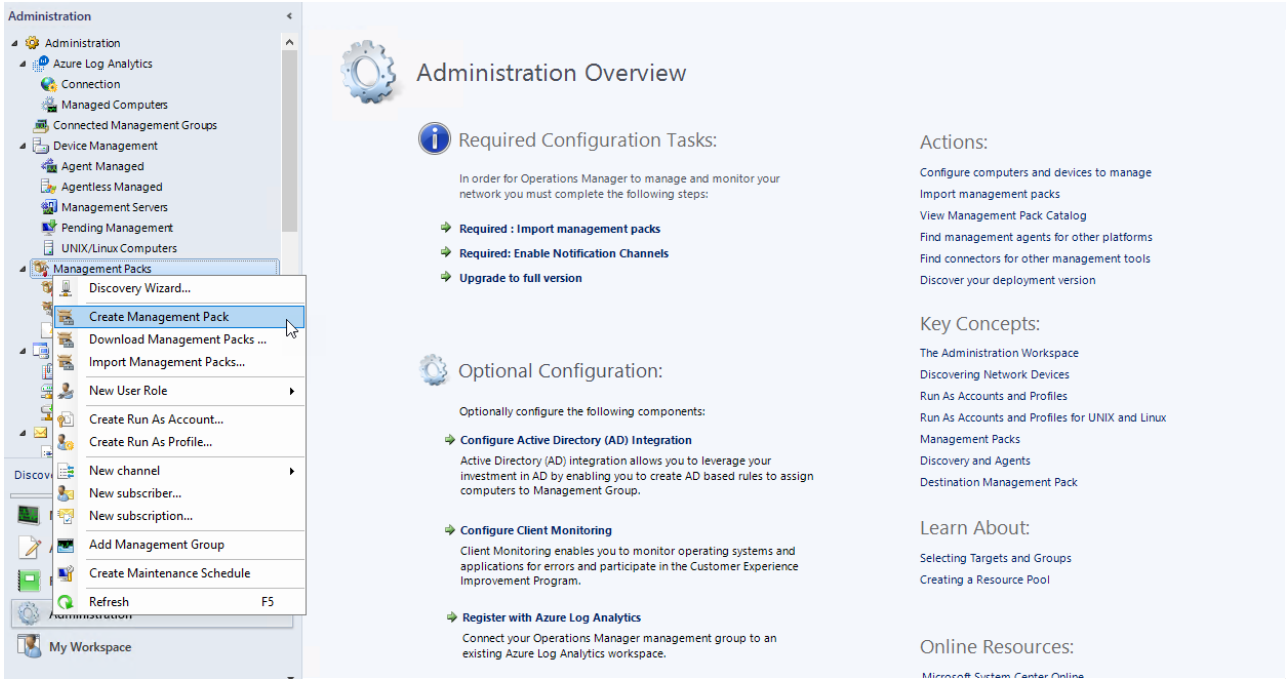
- Quick export of customized settings from a test environment to production environment.
- You do not have to remove dependencies when removing a management pack with overrides.
- If customizations for all management packs are saved to the default management pack and you want to remove a single pack, you must first remove the default management pack, which also removes customizations for other management packs.

For more information about sealed and unsealed management packs, see Management Pack Formats.

For more information about management pack customizations and the default management pack, see About Management Packs in Operations Manager.

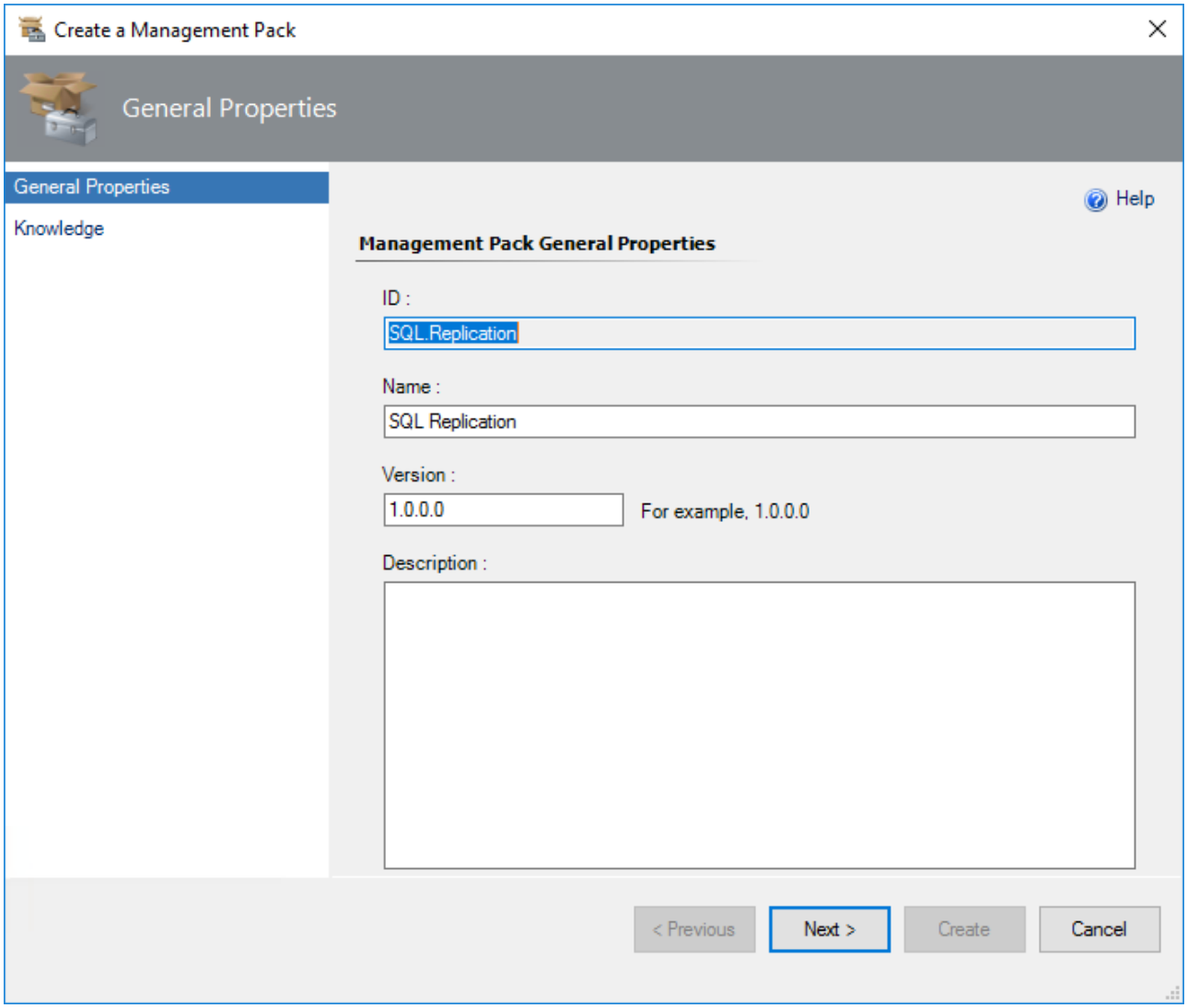
Creating New Management Pack for Customizations

1. Open the Operations Manager console.
2. In the **Administration** view, right-click **Management Packs** and select **Create New Management Pack**.



3. Enter a new name and click **Next**.

4. Click **Create**.



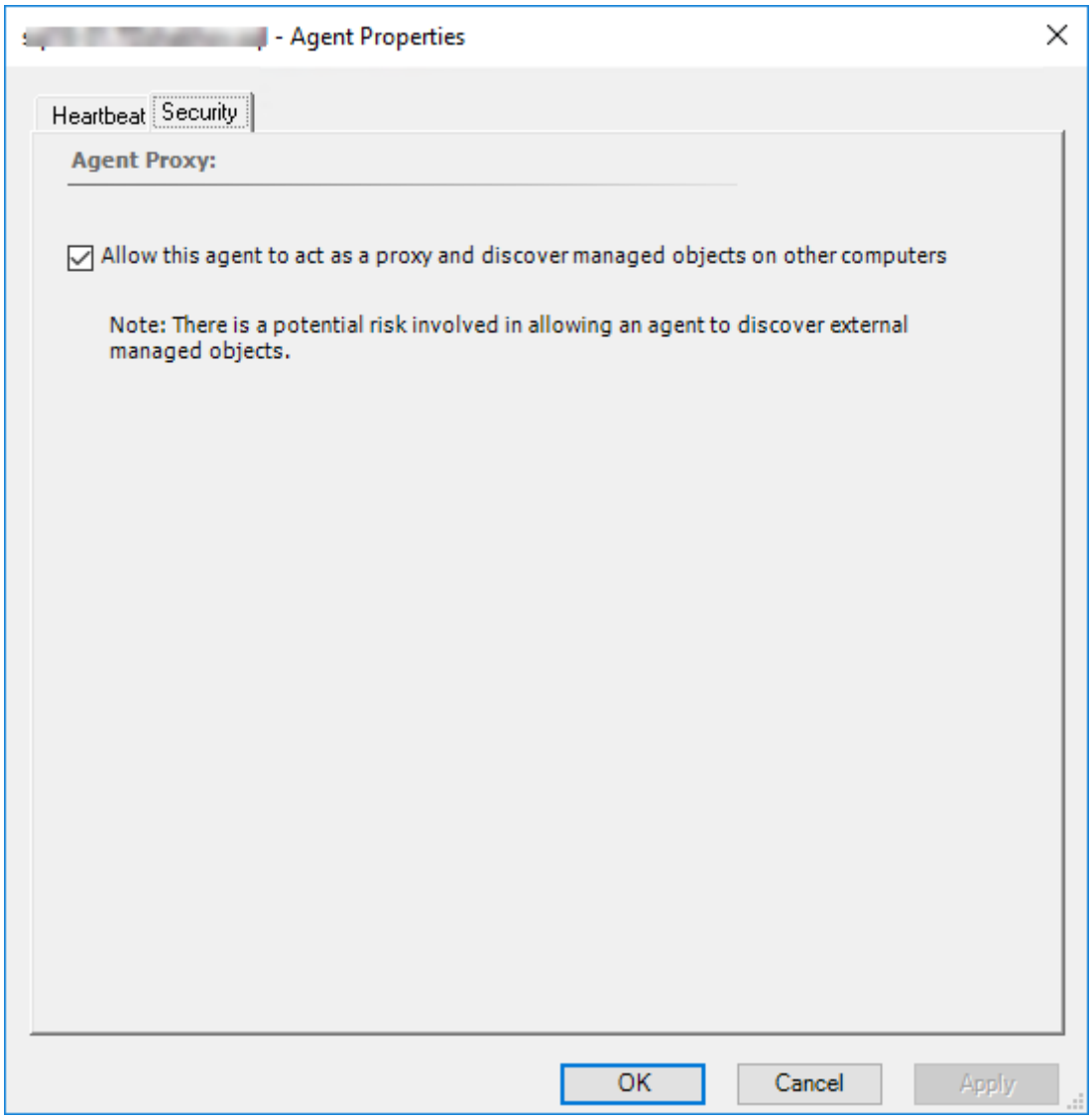
Importing Management Pack

For more information about importing management packs, see How to Import an Operations Manager Management Pack.

Enabling Agent Proxy Option

To enable the **Agent Proxy** option, perform the following steps:

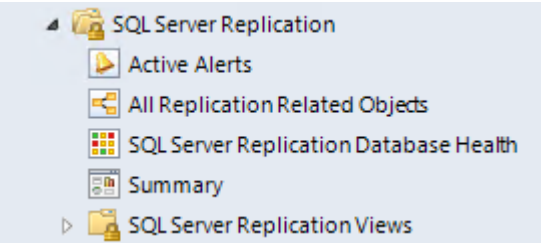
1. Open the Operations Manager console.
2. In the **Administration** view, select **Agent Managed**.
3. Double-click an agent.
4. On the **Security** tab, select the **Allow this agent to act as a proxy and discover managed objects on other computers** checkbox.



Version-Independent (Generic) Views and Dashboards

Management Pack for Microsoft SQL Server Replication uses common folder structure introduced in the first release of Management Pack for SQL Server.

The following views and dashboards are version-independent and show information about all versions of SQL Server.



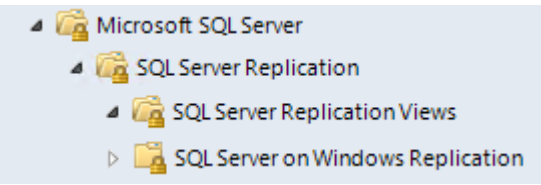
The *All Replication Related Objects* diagram view provides information about all SQL Server Replication objects and their relations.

The *SQL Server Replication Database Health* state view provides information about all databases participating in replication as published database.

From this view, it is easy to open the diagram view specific to the published database.

SQL Server Replication Views

Management Pack for Microsoft SQL Server Replication introduces the comprehensive set of state, performance and alert views.



Dashboards

Management Pack for Microsoft SQL Server Replication includes a set of dashboards that provide detailed information about SQL Server Replication.

Each dashboard has a navigation widget (located in the leftmost part of the dashboard) that can be used to switch the current presentation context. Information displayed by other widgets depends on the object that was selected in the navigation widget.

Replication dashboards have the following personalization settings:

- *Refresh Rate* – this setting defines how often the dashboard refreshes data on a client. This setting does not change the actual collection frequency of metrics on a server.
- *Time Interval* – this setting defines for which period to display data. The *Performance* widget on the "Instance" view depends on this setting.
- *Background Color* – change the background color for all views.

Use the menu button or a group in order to add a group or tile. To delete or edit a tile, right-click a tile and select the required action.

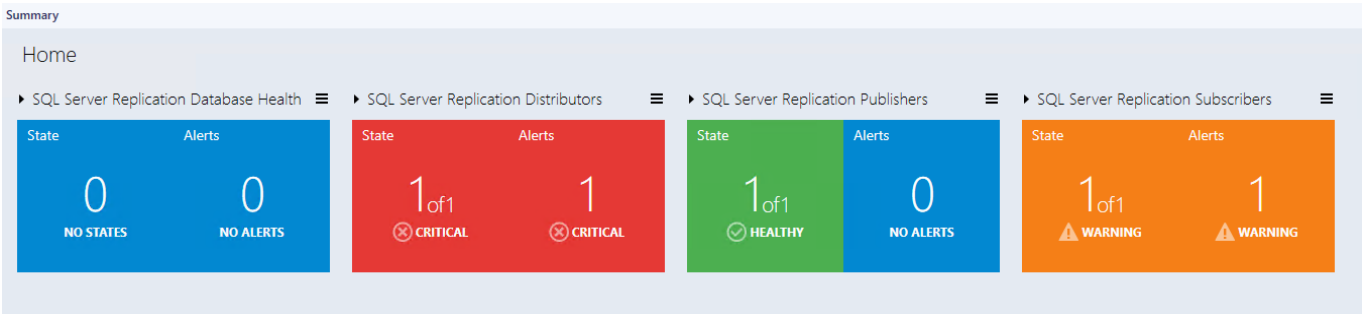
The background color, time interval and refresh rate settings are applied to the *Datacenter Dashboard* and all *Instance Dashboards*, and can be set from the *Datacenter Dashboard* menu.

For more information, see the guide to Microsoft SQL Server dashboards.

Replication Components Datacenter Dashboard

The Replication Components Datacenter dashboard is a dashboard for SQL Server version-independent replication. This dashboard contains four groups by default:

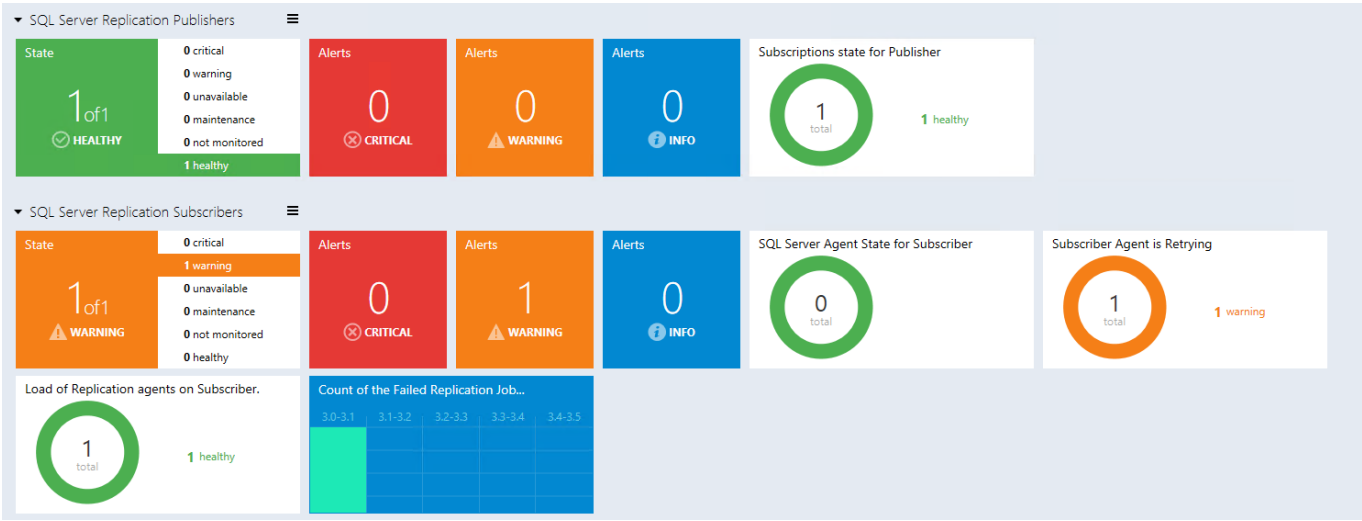
- Replication Database Health Group
- Distributors Group
- Publishers Group
- Subscribers Group



SQL Server Replication Datacenter Dashboard

The SQL Server Replication Datacenter dashboard is a specific dashboard for SQL Server replication.

This dashboard contains only the SQL Server replication group that contains all SQL Server distributors, publishers and subscribers.



Appendix: Known Issues and Troubleshooting

A "SQL Server Replication Database Health" virtual group may be empty in the "Summary" dashboards view

Issue: A *SQL Server Replication Database Health* virtual group may be empty in the **Summary** dashboards view even if configured SQL replications discovered.

Resolution: Create a regular group containing “MSSQL: Generic Replication Database Health” class objects and restart the Operations Manager console.

Offline Publication and Subscription databases are not shown in the monitoring list

Issue: If Publication or Subscription databases have been set offline, these databases will be undiscovered and will not be shown in the System Center Operations Manager console. After you bring these databases online, they will be automatically rediscovered and available for monitoring.

Resolution: No resolution.

The "Replication Agent State" monitor fails for Pull subscriptions on SQL Server Express editions

Issue: [Applicable to SQL Server Express editions] If you select the **Run each agent at its Subscriber (pull subscriptions)** option in the **Distribution Agent Location** wizard when configuring a Subscriber, the *Replication Agent State* monitor will fail with errors at the Distributor replication role.

Resolution: No resolution.