**Purpose**

The purpose of this guide is to provide a comprehensive roadmap for deploying and configuring an Enterprise Geodatabase (EGDB) using Microsoft SQL Server on Windows Server 2019 virtual machines (VMs). This guide is designed to assist GIS administrators, database administrators (DBAs), and IT professionals in setting up a robust and scalable geospatial data management environment using ArcGIS Enterprise 10.8.1. The guide outlines each step of the deployment process, from setting up the VMs and installing SQL Server to configuring the geodatabase and loading spatial data, ensuring a systematic and error-free implementation.

**Scope**

This guide covers the following key steps involved in deploying and configuring an Enterprise Geodatabase using SQL Server:

1. **Deploying Virtual Machines (VMs) with Windows Server 2019:**
   * Specifications and resource allocation
   * Installation and configuration of Windows Server 2019
2. **Installing Microsoft SQL Server and SQL Server Management Studio (SSMS):**
   * Downloading and installing SQL Server and SSMS
   * Installing necessary ODBC drivers compatible with ArcGIS Enterprise 10.8.1
3. **Creating Service Accounts and Assigning Permissions:**
   * Creating service accounts in Active Directory or as local SQL Server accounts
   * Granting appropriate permissions, including addressing the challenges of assigning db\_owner permissions in a decentralized GIS business model
4. **Setting up the Enterprise Geodatabase (EGDB):**
   * Using ArcGIS Pro to create and configure the geodatabase
   * Verifying the setup through system tables and schema checks
5. **Registering the Database with ArcGIS Server:**
   * Registering the SQL Server database as a datastore in ArcGIS Server
   * Validating the connection to ensure accessibility
6. **Initializing and Connecting to the SQL Database:**
   * Establishing a connection to the SQL database using ArcGIS Pro
   * Initializing the database for use with ArcGIS and verifying the setup
7. **Creating Features and Loading Data:**
   * Creating new feature classes or importing existing data using ArcGIS Pro
   * Loading data into the geodatabase and ensuring it is accessible

The guide also includes references to relevant Esri documentation and best practices, providing additional context and support for each step of the deployment process. This ensures that all procedures are in line with industry standards and leverage the full capabilities of ArcGIS Enterprise.

**ABOUT THIS GUIDE**

The content in this guide provides a detailed roadmap for deploying and configuring an Enterprise Geodatabase (EGDB) using Microsoft SQL Server on Windows Server 2019 virtual machines. This guide references the software manufacturer’s online help documentation specific to ArcGIS Enterprise and SQL Server. These help topics are noted, where applicable, and the links to the specific topics are in alphabetical order in Appendix A.

The guide is structured to ensure that each step of the deployment process is clearly defined and follows best practices, leveraging the full capabilities of ArcGIS Enterprise. The procedures outlined in this guide include references to Esri documentation for further information and support.

**Prerequisites**

Before beginning the deployment and configuration of the Enterprise Geodatabase (EGDB), ensure the following prerequisites are met:

1. **Hardware and Software Requirements:**
   * Adequate hardware resources to host the virtual machines (VMs) with Windows Server 2019.
   * Installation media or ISO file for Windows Server 2019.
   * Installation files for Microsoft SQL Server and SQL Server Management Studio (SSMS) 18.11.
   * Compatible ODBC driver for ArcGIS Enterprise 10.8.1.
2. **Accounts and Permissions:**
   * Administrative access to the virtual machine infrastructure for creating and managing VMs.
   * Obtain GIS SQL service account login to make a connection to the database. It should use Windows login credentials (typically the service account that runs the GIS Server service). Reference: [Adding registered databases](https://enterprise.arcgis.com/en/server/10.8/cloud/azure/add-registered-databases.htm#ESRI_SECTION1_D8CC3BD596B84360B1EA0D22BA06298A).
   * Obtain an ArcGIS Server keycodes file and place it in a location accessible from the ArcGIS client used to create the geodatabase.
   * A service account with db\_owner permissions in SQL Server for setting up the EGDB.
   * User accounts with appropriate permissions for creating and managing features in the geodatabase.
   * Ensure necessary permissions and coordination with the DBA if the database administration is decentralized.
3. **Software Installation:**
   * ArcGIS Pro installed on a machine with access to the SQL Server database.
   * ArcGIS Server installed and configured in your environment.
4. **Networking and Security:**
   * Proper network configurations to ensure communication between the VMs, SQL Server, and ArcGIS Server.
   * Firewall rules and security settings allowing necessary ports (e.g., TCP port 1433 for SQL Server) to be open.
   * Coordination with the Information System Security Officer (ISSO) and other relevant stakeholders to address any security concerns, especially regarding permissions and access.
5. **Documentation and Resources:**
   * Access to Esri's online help documentation and tutorials for ArcGIS Enterprise and SQL Server.
   * Relevant organizational policies and procedures for managing IT infrastructure and user permissions.
   * Appendix A of this guide, which includes links to all referenced documents and additional resources.

Ensuring these prerequisites are met will help streamline the deployment process and minimize potential issues during the setup and configuration of the Enterprise Geodatabase.

**Checklist for Deploying VMs with SQL Server and Setting up Enterprise Geodatabases**

**Step 1: Deploy VMs with Windows Server 2019**

1. **Task:** Deploy VMs with Windows Server 2019.
   * **Checklist:**
     + Configure VM specifications and allocate resources.
     + Install Windows Server 2019 on the VMs.
     + Ensure network configurations and access settings are correctly set up.

**Step 2: Install Microsoft SQL Server and SSMS**

1. **Task:** Install Microsoft SQL Server and SQL Server Management Studio (SSMS) 18.11.
   * **Checklist:**
     + Download and install Microsoft SQL Server.
     + Install SQL Server Management Studio (SSMS) 18.11.
     + Install the ODBC driver compatible with ArcGIS Enterprise 10.8.1.
     + Verify the installation by connecting to the SQL Server instance using SSMS.

**Step 3: Create a Service Account and Assign Permissions**

1. **Task:** Create a service account and assign appropriate permissions in SQL Server.
   * **Checklist:**
     + Create a service account in Active Directory or as a local SQL Server account.
     + Grant the service account db\_owner permissions on the relevant databases.
     + Identify users who will be creating features and determine their required permissions.
     + Grant appropriate permissions (read/write) to users who will create features in the database.
     + Obtain GIS SQL service account login to make a connection to the database using Windows login (service account that runs the GIS Server service). Reference: [Adding registered databases](https://enterprise.arcgis.com/en/server/10.8/cloud/azure/add-registered-databases.htm#ESRI_SECTION1_D8CC3BD596B84360B1EA0D22BA06298A).
     + Obtain an ArcGIS Server keycodes file and place it in a location accessible from the ArcGIS client used to create the geodatabase.
     + **Note:** Discuss permissions with ISSO and Diplomatic Security to ensure data security:
       - Schedule a meeting with ISSO and Diplomatic Security.
       - Discuss the necessity of db\_owner permissions for creating new constructs in the database.
       - Explore possible solutions or compromises to ensure Diplomatic Security can use the database.

**Step 4: Setup Enterprise Geodatabase (EGDB)**

1. **Task:** Create an Enterprise Geodatabase (EGDB) in SQL Server.
   * **Checklist:**
     + Open ArcGIS Pro and create a new database connection using the service account credentials.
     + Use the Create Enterprise Geodatabase tool to set up the geodatabase.
       - Reference: [Create an enterprise geodatabase in SQL Server](https://pro.arcgis.com/en/pro-app/latest/help/data/geodatabases/manage-sql-server/setup-geodatabase-sqlserver.htm)
     + Verify the creation of the geodatabase by checking the system tables and schema.

**Step 5: Register the Database with ArcGIS Server**

1. **Task:** Register the SQL Server database as a datastore in ArcGIS Server.
   * **Checklist:**
     + Open ArcGIS Server Manager and navigate to the Data Stores section.
     + Add the database connection file (.sde) created in ArcGIS Pro as a registered database.
       - Reference: Registering a database with ArcGIS Server
     + Validate the connection to ensure the ArcGIS Server can access the database.

**Step 6: Initialize and Connect to the SQL Database**

1. **Task:** Initialize the SQL database to be used as an EGDB in ArcGIS Pro.
   * **Checklist:**
     + Open ArcGIS Pro and connect to the SQL database using the connection file.
     + Initialize the database for use with ArcGIS by creating necessary tables and configuring settings.
     + Verify the initialization by checking the ability to create and load features.

**Step 7: Create Features and Load Data**

1. **Task:** Create features and load data into the SQL database using ArcGIS Pro.
   * **Checklist:**
     + Use ArcGIS Pro to create new feature classes or import existing data.
     + Load data into the geodatabase using tools such as Simple Data Loader or copy-paste methods.
     + Ensure the data is correctly loaded and accessible through ArcGIS Pro.
       - Reference: Loading data into the geodatabase
2. **Testing and Verification:**
   * **Task:** Test the functionality of the geodatabase after creation and data loading.
     + **Checklist:**
       - Create and edit features in the geodatabase.
       - Perform spatial queries and analyses.
       - Verify that all operations are functioning correctly and efficiently.
3. **Security and Maintenance:**
   * **Task:** Implement and review best practices for database security and maintenance.
     + **Checklist:**
       - Use strong passwords for all accounts.
       - Grant least privilege permissions to users.
       - Regularly review and update security configurations.
       - Perform routine maintenance and backups.
4. **Versioning (Optional):**
   * **Task:** Implement versioning for managing edits and tracking changes in the geodatabase.
     + **Checklist:**
       - Understand the versioning workflows supported by ArcGIS Enterprise.
       - Register datasets as versioned in the geodatabase.
       - Create and manage versions for different editing scenarios.
       - Reconcile and post changes as needed.
       - Reference: [Versioning Types](https://pro.arcgis.com/en/pro-app/latest/help/data/geodatabases/overview/versioning-types.htm)

**References**

1. **CfA ArcGIS Enterprise MSSQL Roadmap to EGDB (Internal document)** - This document provides a step-by-step guide to setting up SQL Server and configuring it for use with ArcGIS Enterprise【57†CfA ArcGIS Enterprise MSSQL Roadmap to EGDB】.
2. **Comparison of Geodatabase Owners in SQL Server (Internal document)** - This document outlines the differences between dbo and sde schemas in SQL Server geodatabases【58†Comparison of Geodatabase Owners in SQL Server】.
3. **Managed DB vs Non Managed DB (Internal document)** - This document explains the differences between registered and managed databases in ArcGIS Server【58†Managed DB vs Non Managed DB】.
4. **SQL and Enterprise Geodatabases (Internal document)** - This document provides an overview of using SQL with enterprise geodatabases, including accessing, editing, and creating tables【57†SQL and Enterprise Geodatabases】.

**Esri Documentation References**

* **Database Requirements for SQL Server**: [Database requirements SQL Server](https://enterprise.arcgis.com/en/system-requirements/latest/windows/database-requirements-sqlserver.htm)
* **Overview Geodatabases in SQL Server**: [Overview Geodatabases in SQL Server](https://pro.arcgis.com/en/pro-app/3.1/help/data/geodatabases/manage-sql-server/overview-geodatabases-sqlserver.htm)
* **Comparison of Geodatabase Owners in SQL Server**: [Comparison of geodatabase owners in SQL Server](https://pro.arcgis.com/en/pro-app/latest/help/data/geodatabases/manage-sql-server/comparison-geodatabase-owners-sqlserver.htm)
* **Connect to SQL Server from ArcGIS**: [Connect to SQL Server from ArcGIS](https://enterprise.arcgis.com/en/server/latest/manage-data/windows/connect-sqlserver.htm)
* **Create a Geodatabase in SQL Server**: [Create a geodatabase in SQL Server](https://pro.arcgis.com/en/pro-app/latest/help/data/geodatabases/manage-sql-server/setup-geodatabase-sqlserver.htm)
* **Loading data into the geodatabase**: Loading data into the geodatabase
* **Versioning Types**: [Versioning Types](https://pro.arcgis.com/en/pro-app/latest/help/data/geodatabases/overview/versioning-types.htm)

**Importance of db\_owner Permissions for Data Creation in ArcGIS Pro**

In ArcGIS Pro, db\_owner permissions are crucial for creating new constructs in the database because these permissions allow the user to perform a wide range of administrative tasks that are essential for setting up and managing the geodatabase. These tasks include creating and modifying tables, schemas, stored procedures, and other database objects that are necessary for storing and managing spatial data efficiently. Without db\_owner permissions, users would be limited in their ability to make these necessary changes, potentially hindering the functionality and performance of the geodatabase. Therefore, ensuring that the appropriate users have db\_owner permissions is critical for the successful deployment and management of an enterprise geodatabase.