
HOW TO AUDIT
SQL SERVER
FOR FREE

# ABOUT ME

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20+ years IT experience

Experienced DBA

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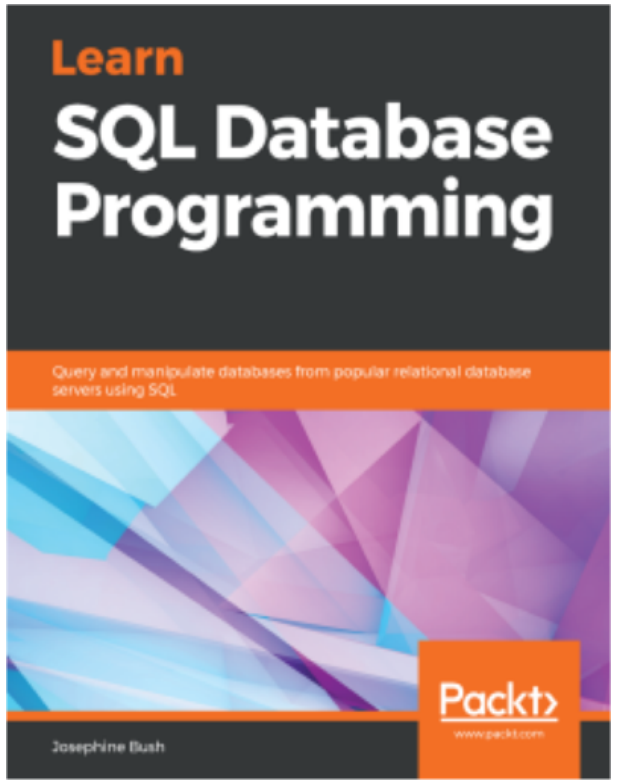



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# AGENDA

Why use auditing?

Problems you can solve

Types and tools you can use

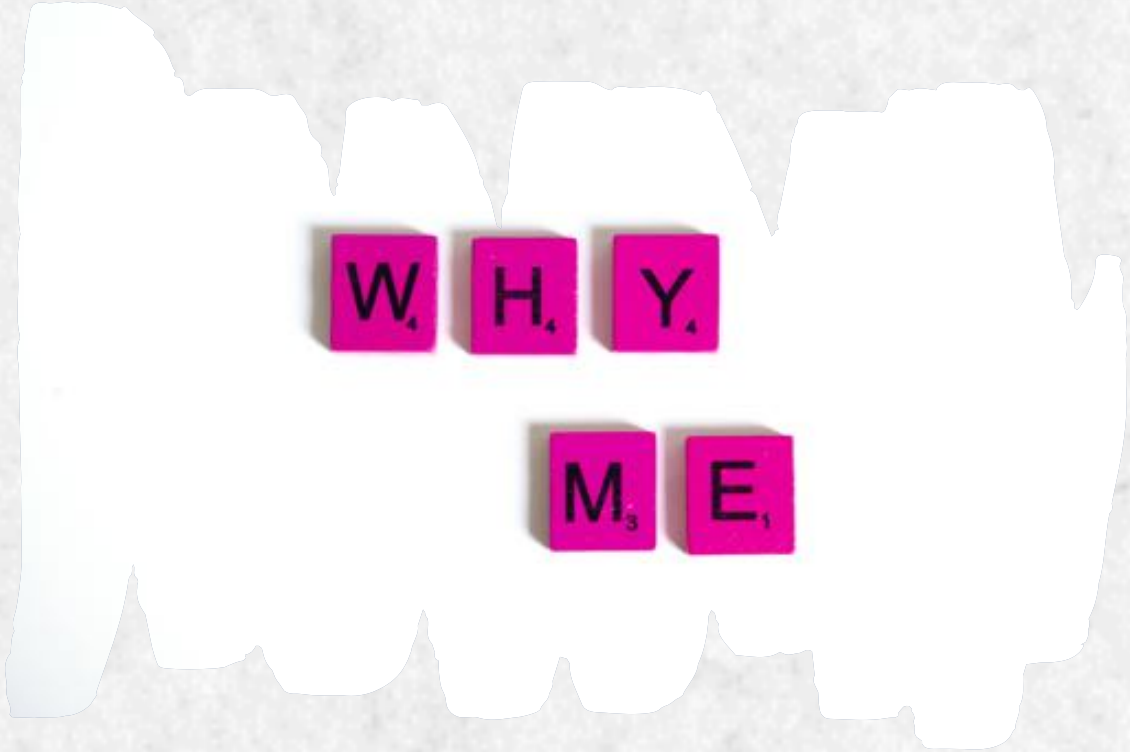
Centralized querying

Reporting

Cloud auditing

# WHAT IS AUDITING?

Collecting and examining information to determine proper use or misuse




# WHY AUDIT?

Maybe your company says they don’t value knowing what’s going on in your databases, but….

# PROBLEMS AUDITING CAN SOLVE

Who broke this?

Who changed this?

Who used this?

You can audit pretty much everything anyone does in SQL Server!

# AUDITING REVIEW

Collecting and examining information to determine proper use or misuse

Helps you know what’s happening on the database server

Helps you report who made what changes

# HOW TO AUDIT SQL SERVER

SQL Server audit

is built-in auditing

functionality

available via SSMS

# SQL SERVER AUDIT AVAILABILITY

| Version | Server audit edition | Database audit edition |
|---|---|---|
| 2008 | Only available in enterprise | Only available in enterprise |
| 2012 and 2014 | Available in all editions | Only available in enterprise |
| 2016, 2017, 2019 | Available in all editions | Available in all editions |

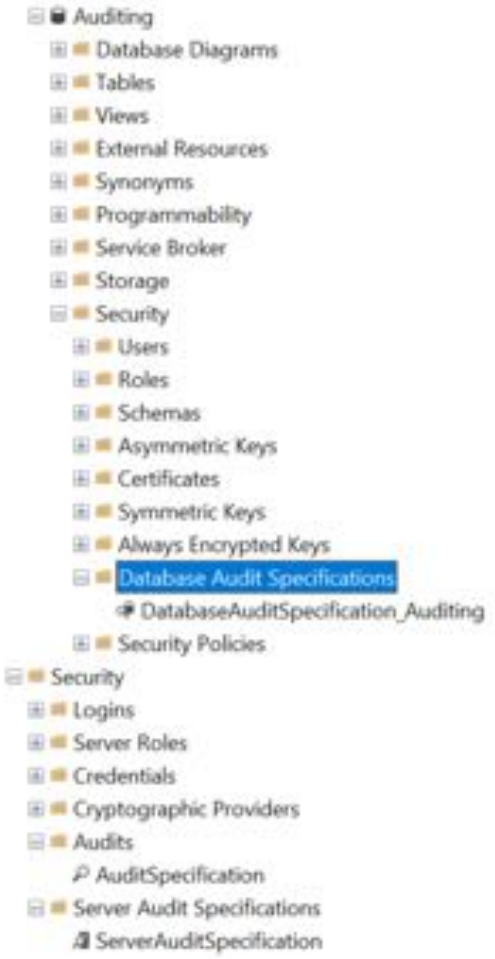
# SQL SERVER AUDIT REQUIREMENTS

You need two things to make this work:

One audit specification (required)

And one of these things:

1. A server audit specification
2. A database audit specification



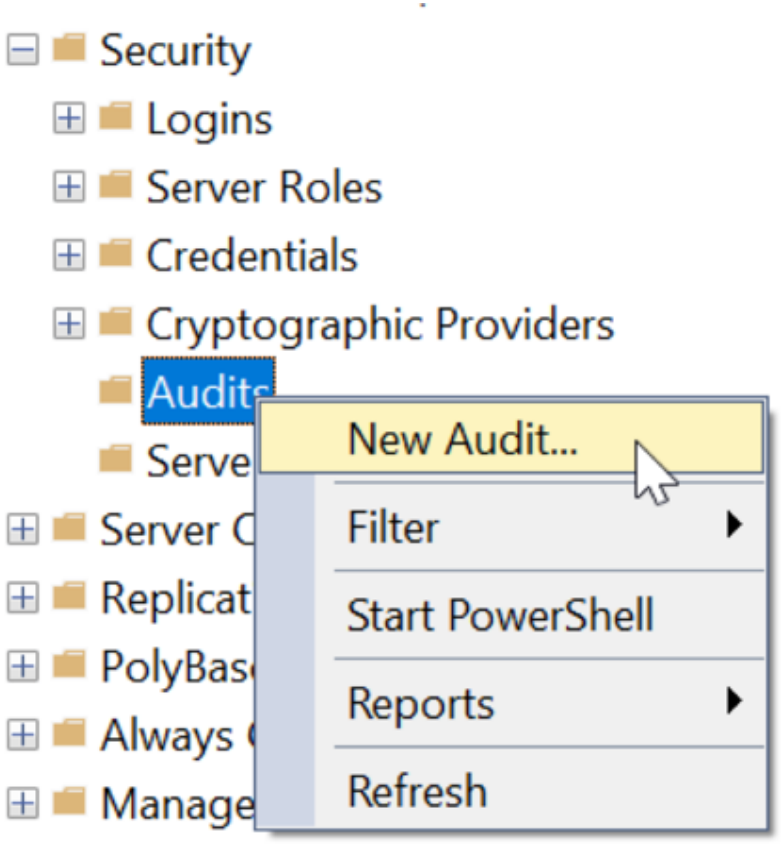
# SQL SERVER AUDIT USE CASES

A server audit specification is good for auditing server level and/or all databases at the same time

A database audit specification is good for auditing one database or a subset of activities in one database

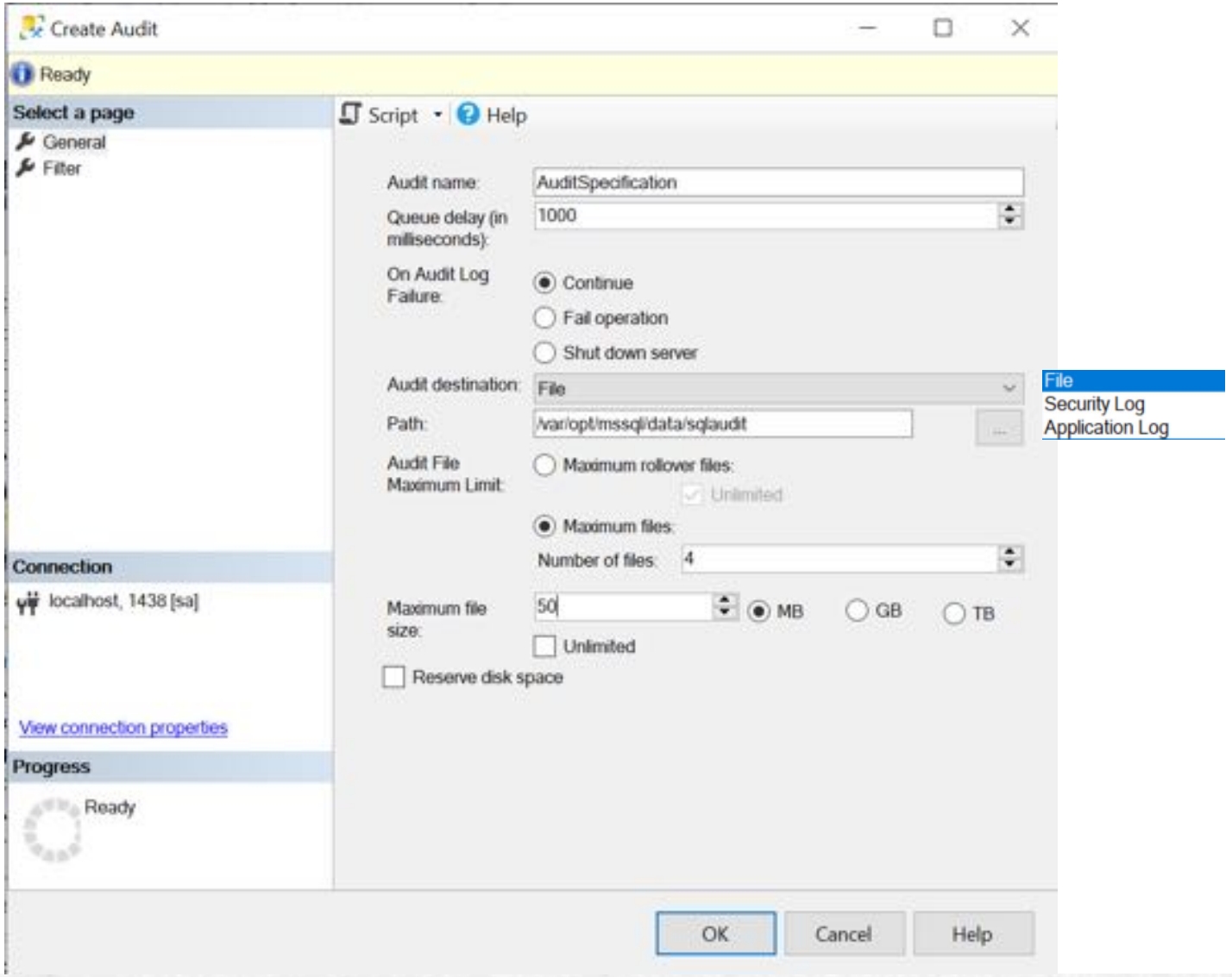
# CREATE AUDIT VIA GUI

Creating an audit specification in SSMS



# CONFIGURE AUDIT VIA GUI

Configuring an audit specification

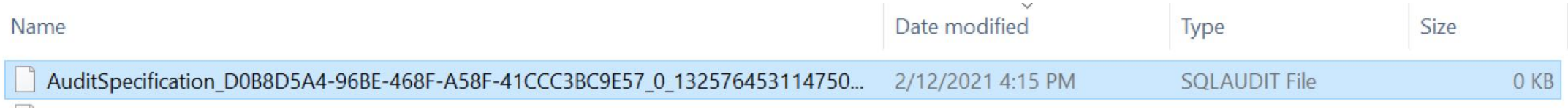


# ENABLING AUDIT VIA GUI

Audit specifications are disabled after creation by default

# AUDIT FILES ON DISK

Once audit is enabled, it will place a file on disk



# AUDIT CATEGORIES

**Server-level actions**

These capture permission changes and creating databases.  Includes any action that doesn't start with schema or database

**Database-level actions**

These include data manipulation languages (DML) and data definition language (DDL) changes. Namely things at the database level.  Includes any action that starts with schema or database

**Audit-level actions**

These include actions in the auditing process, such as creating or dropping an audit specification. This is the AUDIT_CHANGE_GROUP option.

# SERVER AUDIT ACTION GROUPS

## Commonly used server-level actions

| | |
|---|---|
| SERVER_OBJECT_CHANGE_GROUP | Captures CREATE, ALTER, or DROP actions at server level. |
| SERVER_OBJECT_OWNERSHIP_CHANGE_GROUP | Captures when the owner of a server object is changed. |
| SERVER_OBJECT_PERMISSION_CHANGE_GROUP | Captures when GRANT, REVOKE, or DENY on a server object permission |
| SERVER_OPERATION_GROUP | Captures changes like altering settings, resources, external access, or authorization |
| SERVER_PERMISSION_CHANGE_GROUP | Captures when GRANT, REVOKE, or DENY for permissions at server level |
| SERVER_PRINCIPAL_CHANGE_GROUP | Captures when server principals are created, altered, or dropped. |
| SERVER_ROLE_MEMBER_CHANGE_GROUP | Captures when a login is added or removed from a fixed server role like db_datareader for example. |
| SERVER_STATE_CHANGE_GROUP | Captures when the SQL Server service state is modified like when it’s restarted after patching |
| LOGIN_CHANGE_PASSWORD_GROUP | Captures when a login password is changed |

# DATABASE AUDIT ACTION GROUPS

## Commonly used database-level actions

| | |
|---|---|
| DATABASE_CHANGE_GROUP | Captures when a database is created, altered, or dropped |
| DATABASE_OBJECT_ACCESS_GROUP | Captures when database objects such as certificates and asymmetric keys are accessed. |
| DATABASE_OBJECT_CHANGE_GROUP | Captures when CREATE, ALTER, or DROP statement is executed on database objects, such as schemas |
| DATABASE_OBJECT_OWNERSHIP_CHANGE_GROUP | Captures when a change of owner for objects within database scope occurs. |
| DATABASE_OBJECT_PERMISSION_CHANGE_GROUP | Captures when a GRANT, REVOKE, or DENY has been issued for database objects, such as assemblies and schemas |
| DATABASE_OWNERSHIP_CHANGE_GROUP | Captures when you use the ALTER AUTHORIZATION statement to change the owner of a database |
| DATABASE_PERMISSION_CHANGE_GROUP | Captures when a GRANT, REVOKE, or DENY is issued for a statement permission |
| DATABASE_PRINCIPAL_CHANGE_GROUP | Captures when principals, such as users, are created, altered, or dropped from a database |
| DATABASE_ROLE_MEMBER_CHANGE_GROUP | Captures when a login is added to or removed from a database role. |

# DATABASE AUDIT ACTION GROUPS

## Other commonly used database-level actions

| | |
|---|---|
| APPLICATION_ROLE_CHANGE_PASSWORD_GROUP | Captures whenever a password is changed for an application role |
| DBCC_GROUP | Captures when a principal issues any DBCC command |
| SCHEMA_OBJECT_CHANGE_GROUP | Captures when a CREATE, ALTER, or DROP operation is performed on a schema |
| SCHEMA_OBJECT_OWNERSHIP_CHANGE_GROUP | Captures when the permissions changes to the owner of schema object |
| SCHEMA_OBJECT_PERMISSION_CHANGE_GROUP | Captures whenever a grant, deny, or revoke is issued for a schema object |

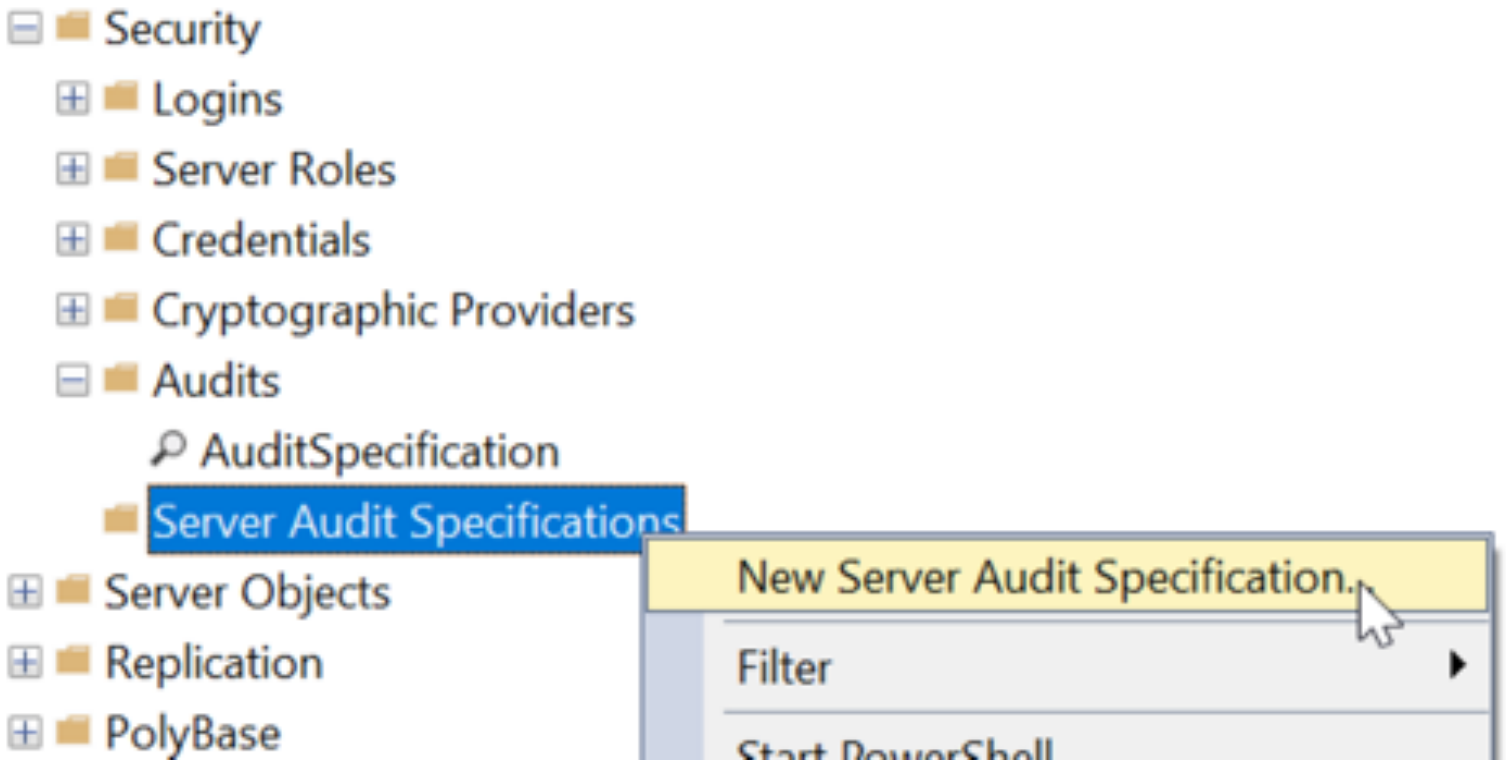
# DATABASE AUDIT ACTIONS

## Capturing data changes

| | |
|---|---|
| SELECT | Captures SELECT statements |
| INSERT | Captures INSERT statements |
| UPDATE | Captures UPDATE statements |
| DELETE | Captures DELETE statements |
| EXECUTE | Captures EXECUTE statements |

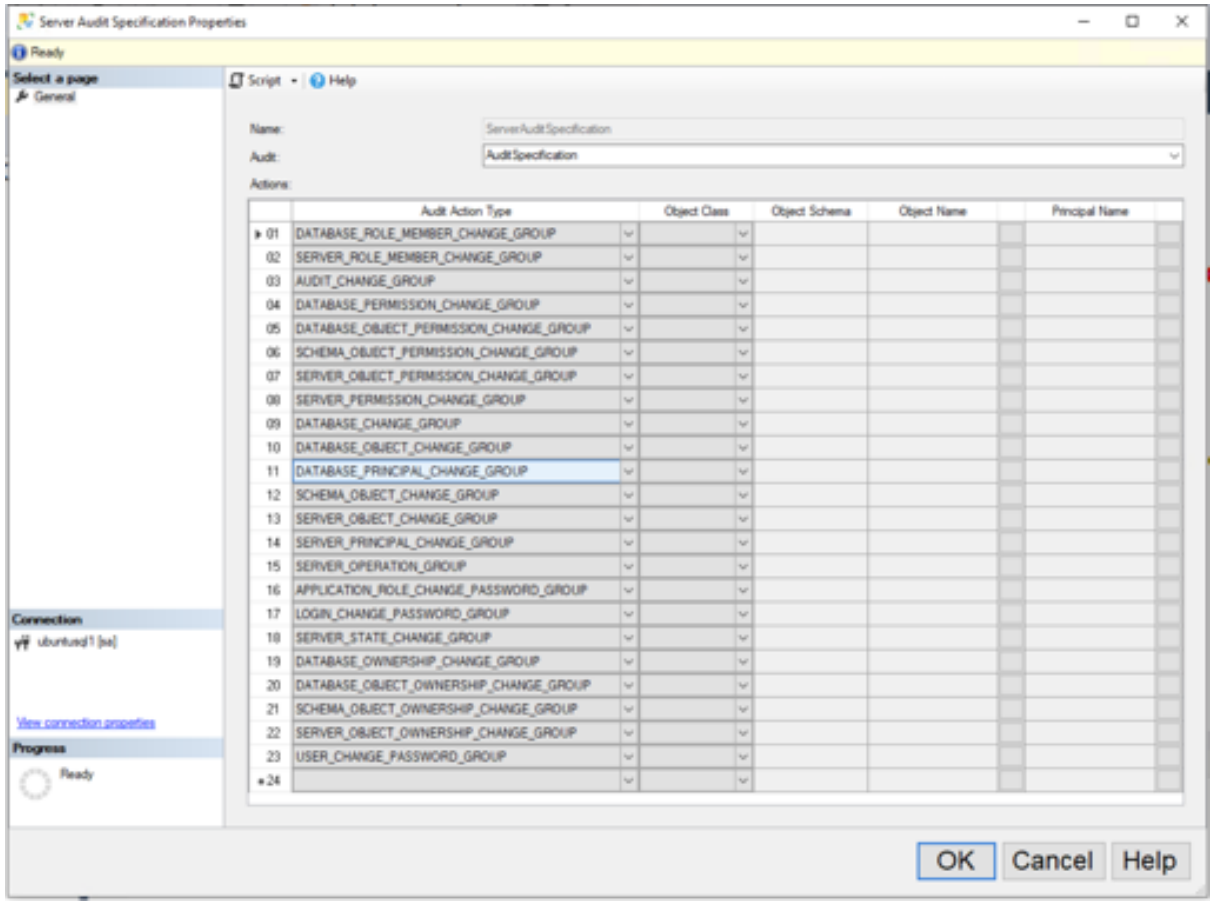
# CREATE SERVER AUDIT VIA GUI

Creating a server audit specification in SSMS



# CONFIGURE SERVER AUDIT VIA GUI

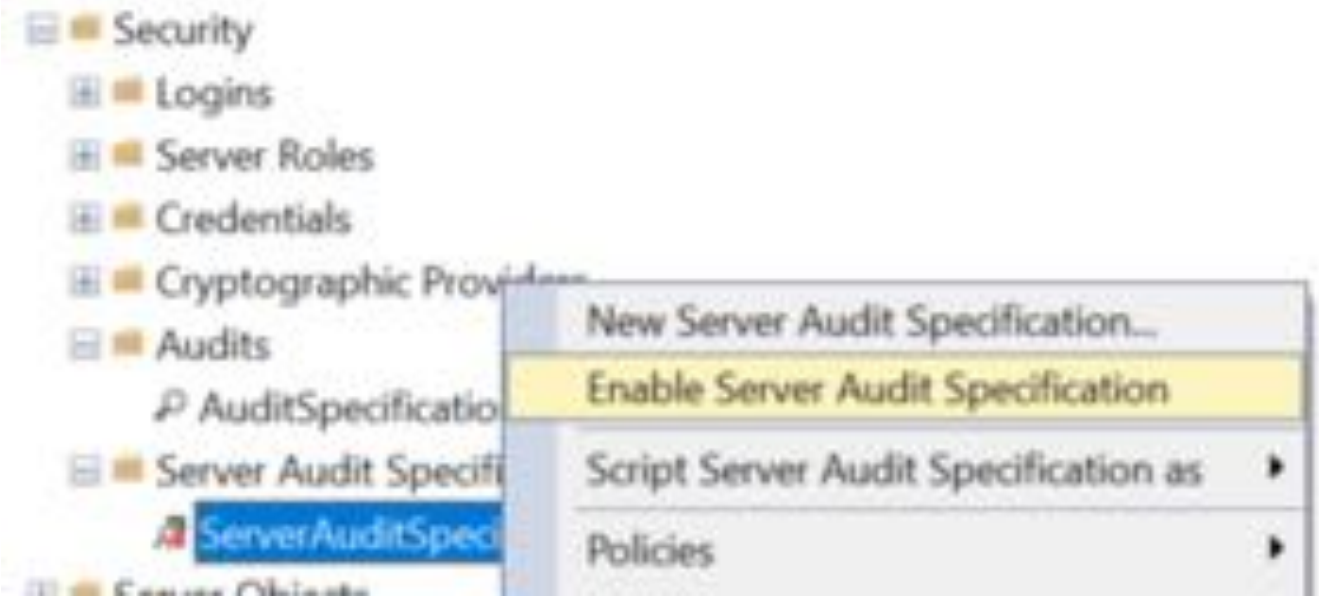
Configuring a server audit specification via SSMS




| | Audit Action Type |
|---|---|
| 01 | DATABASE_ROLE_MEMBER_CHANGE_GROUP |
| 02 | SERVER_ROLE_MEMBER_CHANGE_GROUP |
| 03 | AUDIT_CHANGE_GROUP |
| 04 | DATABASE_PERMISSION_CHANGE_GROUP |
| 05 | DATABASE_OBJECT_PERMISSION_CHANGE_GROUP |
| 06 | SCHEMA_OBJECT_PERMISSION_CHANGE_GROUP |
| 07 | SERVER_OBJECT_PERMISSION_CHANGE_GROUP |
| 08 | SERVER_PERMISSION_CHANGE_GROUP |
| 09 | DATABASE_CHANGE_GROUP |
| 10 | DATABASE_OBJECT_CHANGE_GROUP |
| 11 | DATABASE_PRINCIPAL_CHANGE_GROUP |
| 12 | SCHEMA_OBJECT_CHANGE_GROUP |
| 13 | SERVER_OBJECT_CHANGE_GROUP |
| 14 | SERVER_PRINCIPAL_CHANGE_GROUP |
| 15 | SERVER_OPERATION_GROUP |
| 16 | APPLICATION_ROLE_CHANGE_PASSWORD_GROUP |
| 17 | LOGIN_CHANGE_PASSWORD_GROUP |
| 18 | SERVER_STATE_CHANGE_GROUP |
| 19 | DATABASE_OWNERSHIP_CHANGE_GROUP |
| 20 | DATABASE_OBJECT_OWNERSHIP_CHANGE_GROUP |
| 21 | SCHEMA_OBJECT_OWNERSHIP_CHANGE_GROUP |
| 22 | SERVER_OBJECT_OWNERSHIP_CHANGE_GROUP |
| 23 | USER_CHANGE_PASSWORD_GROUP |
| 24 | |

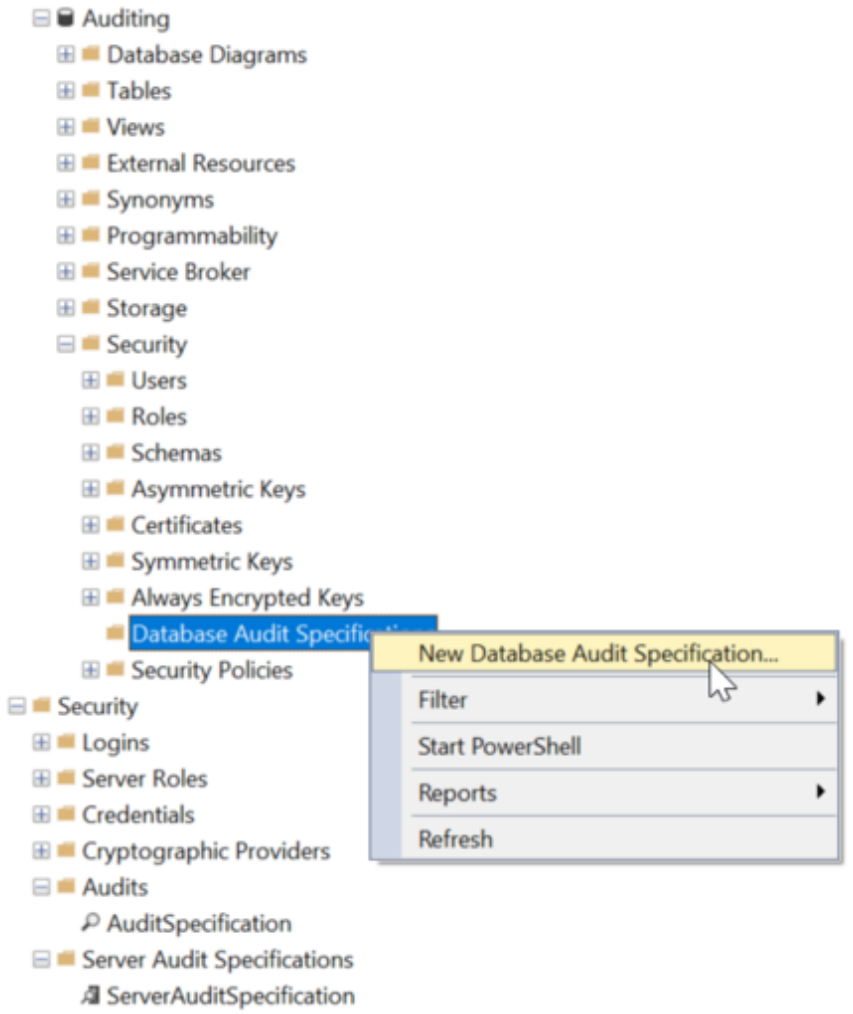
# ENABLING SERVER AUDIT VIA GUI

Server audit specifications are disabled after creation by default



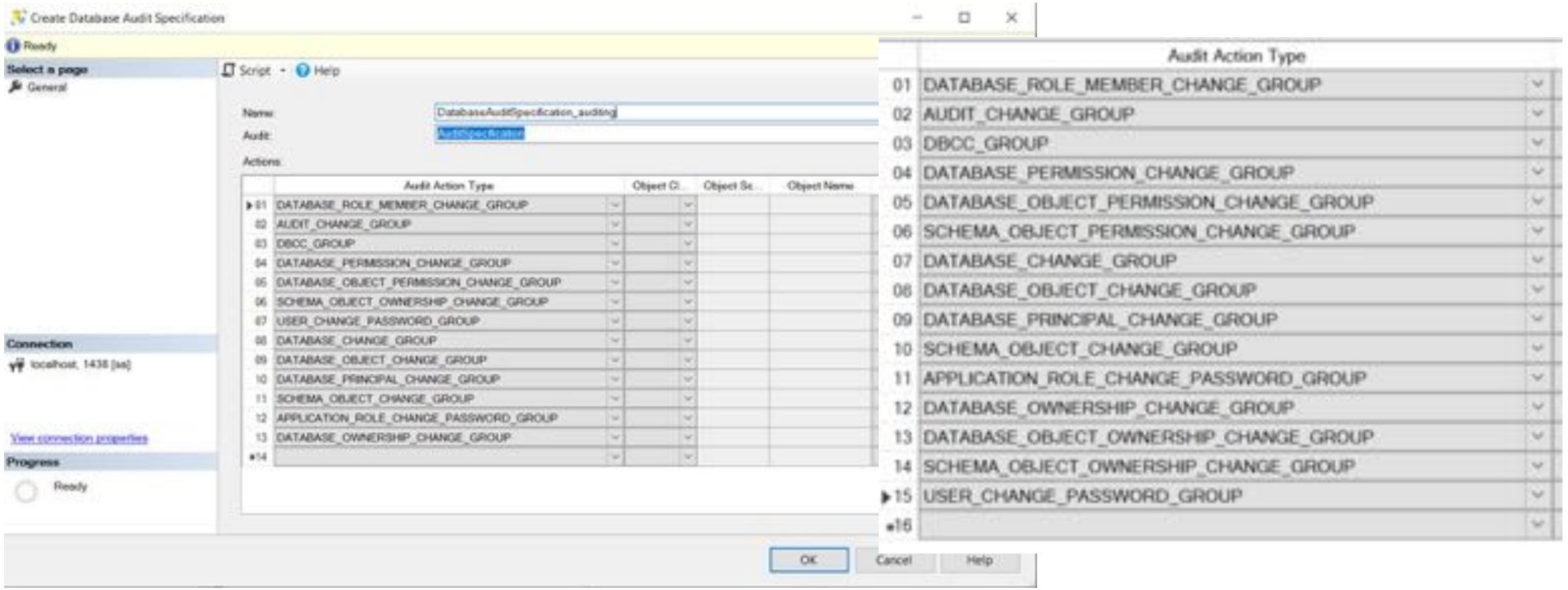
# CREATE DATABASE AUDIT VIA GUI

Creating a database audit specification via SSMS

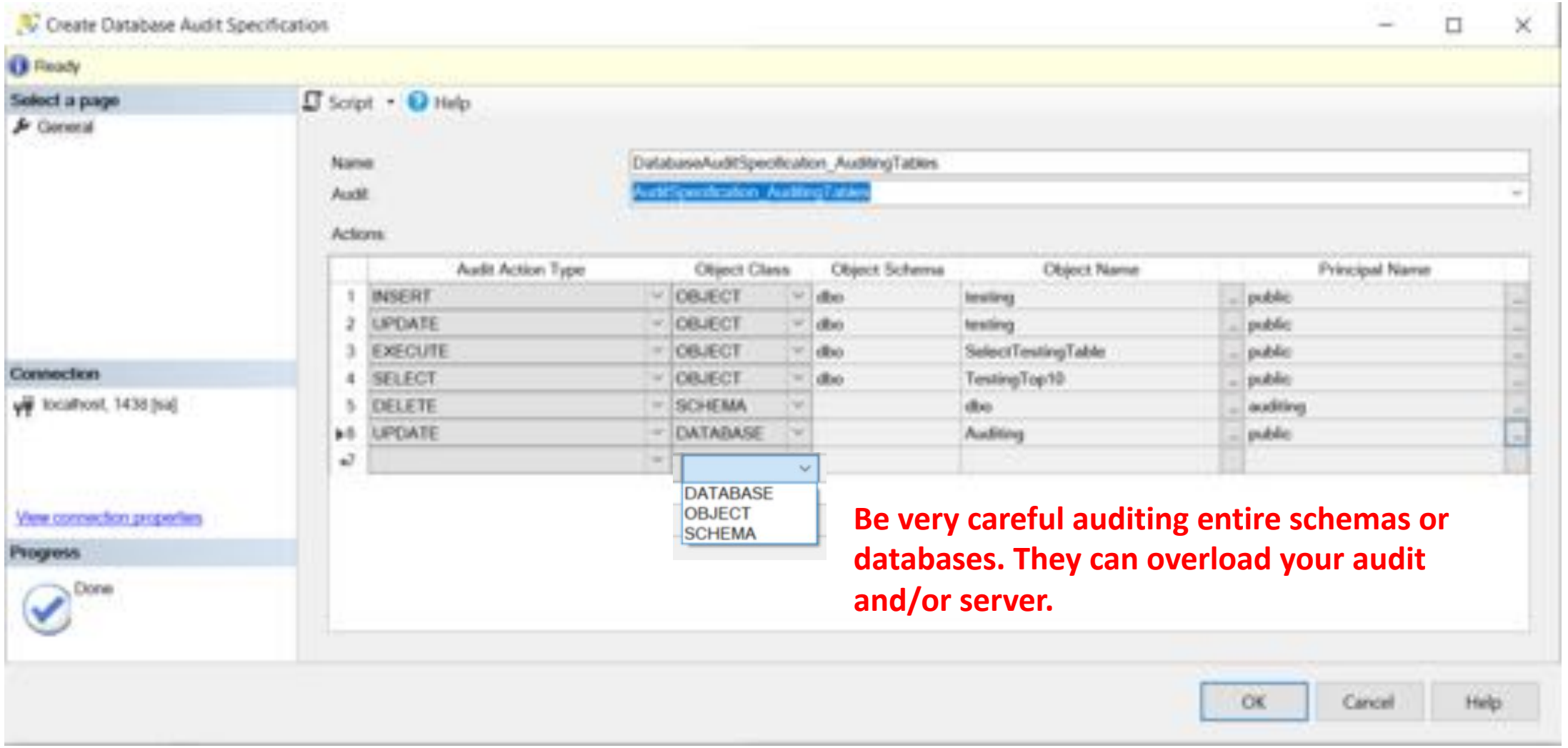


# CONFIGURE DATABASE AUDIT VIA GUI

Configuring a database audit specification via SSMS

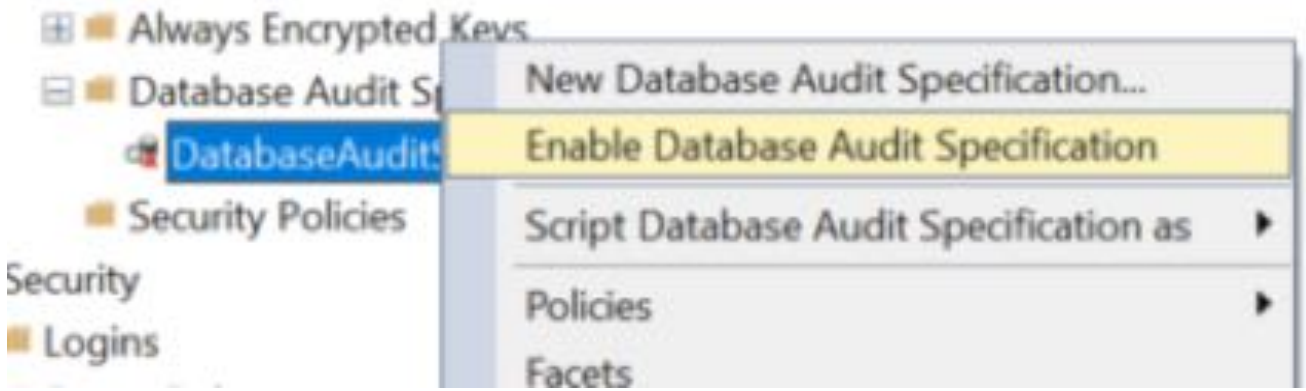


# SQL SERVER AUDIT OBJECTS VIA GUI



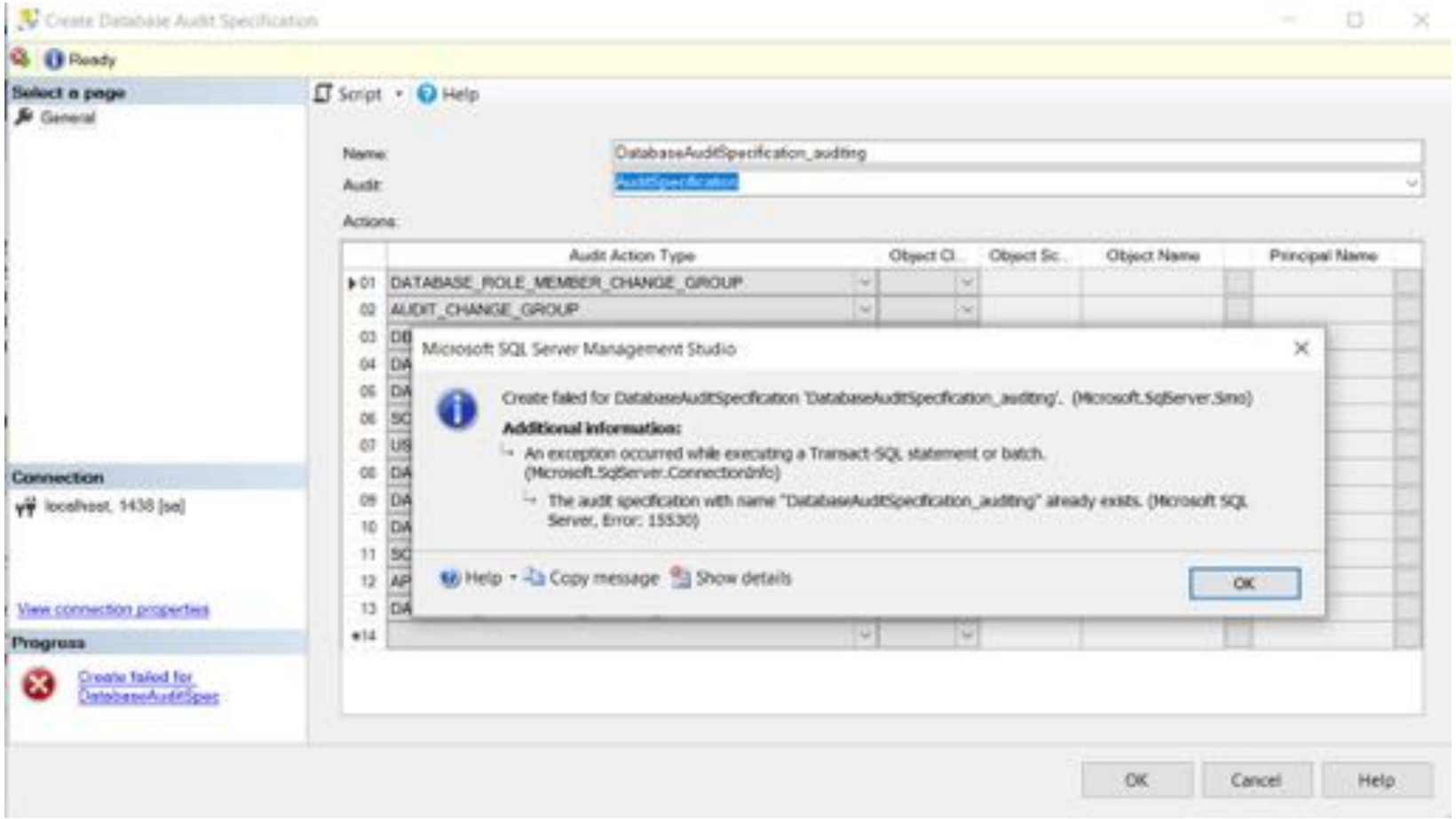
# ENABLING DATABASE AUDIT VIA GUI

Database audit specifications are disabled after creation by default



# ADDING MULTIPLE AUDITS ERROR

You must add additional audit specifications to add additional server or database specifications



# ADDING MULTIPLE AUDITS

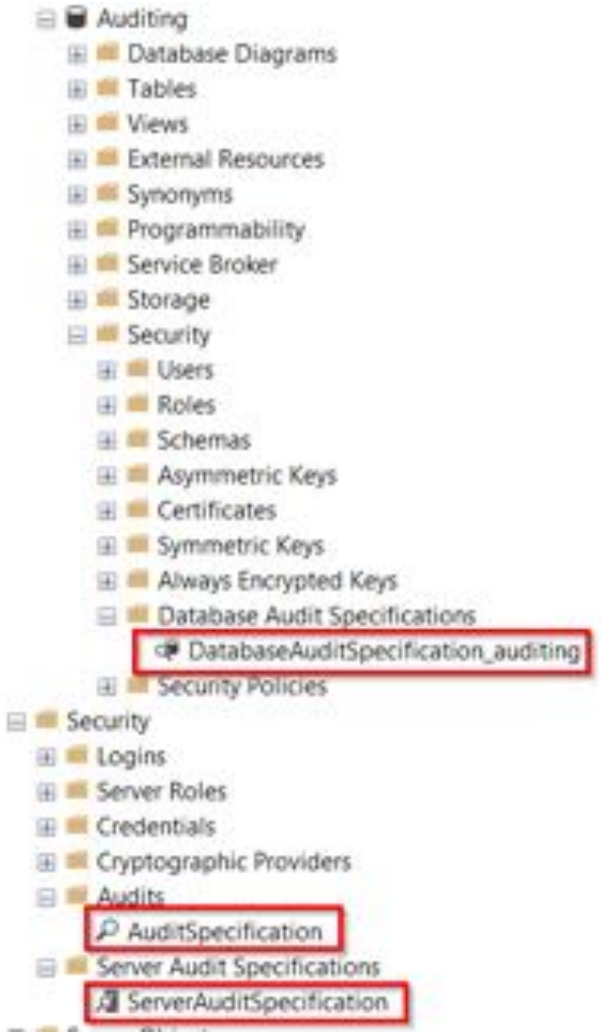
| Audit scenario | Audit specification | Server audit specification | Database audit specification |
|---|---|---|---|
| Auditing schema and perms changes at server and db level | Audit_SchemaPerms | ServerAudit_SchemaPerms | |
| Audit everything sa does | Audit_sa with filter to just get sa user | ServerAudit_sa which includes auditing schema & perms, but also anything else happening at the db level | |

# ADDING MULTIPLE AUDITS

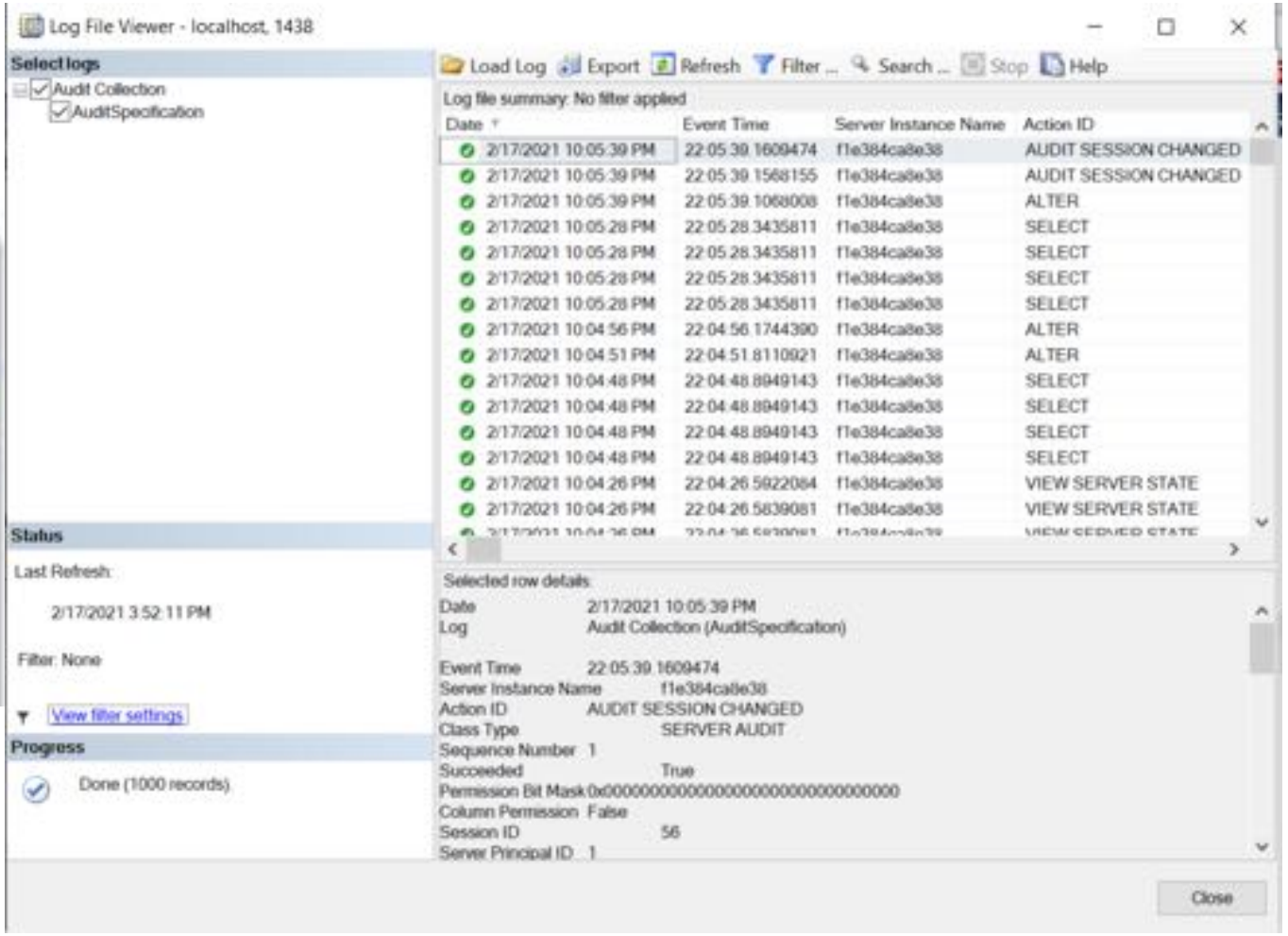
| Audit scenario | Audit specification | Server audit specification | Database audit specification |
|---|---|---|---|
| Audit everyone changing a table | Audit_tblChanges | | DatabaseAudit_tblChanges with insert, update, delete on the table |
| Auditing schema and perms changes at server level and specific database | Audit_Changes | ServerAudit_Changes<br>Don't audit databases at server level | DatabaseAudit_Changes<br>Just on the database you need to audit |

# AUDITS IN GUI

Audits seen in relation to each other



# QUERYING AUDIT VIA GUI

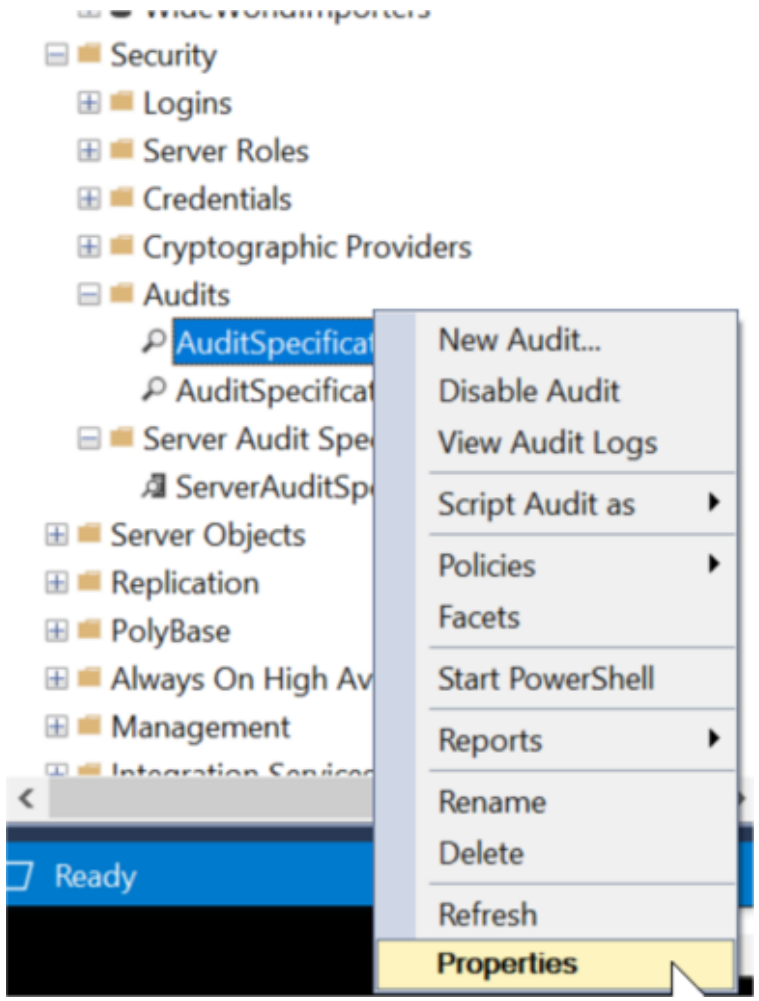



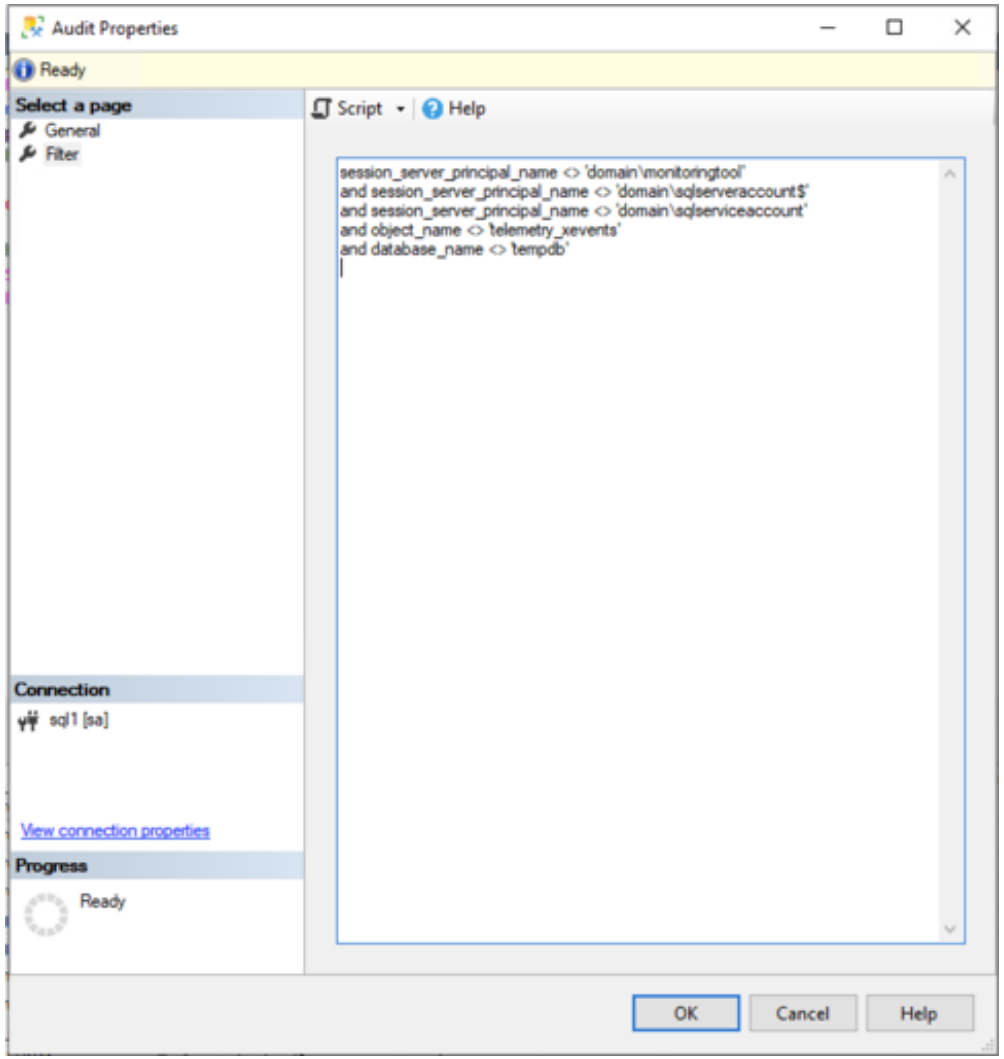
# COLUMNS AVAILABLE IN SQL AUDIT

Different versions of SQL Server have different columns available

| SQL Server 2012/2014/2016 | SQL Server 2017 | SQL Server 2019 |
|---|---|---|
| event_time | event_time | event_time |
| action_id | action_id | action_id |
| succeeded | succeeded | succeeded |
| server_principal_name | server_principal_name | server_principal_name |
| server_instance_name | server_instance_name | server_instance_name |
| database_name | database_name | database_name |
| schema_name | schema_name | schema_name |
| object_name | object_name | object_name |
| statement | statement | statement |
| file_name | file_name | file_name |
| | client_ip | client_ip |
| | application_name | application_name |
| | | host_name |

# FILTERING AUDITS WITH GUI

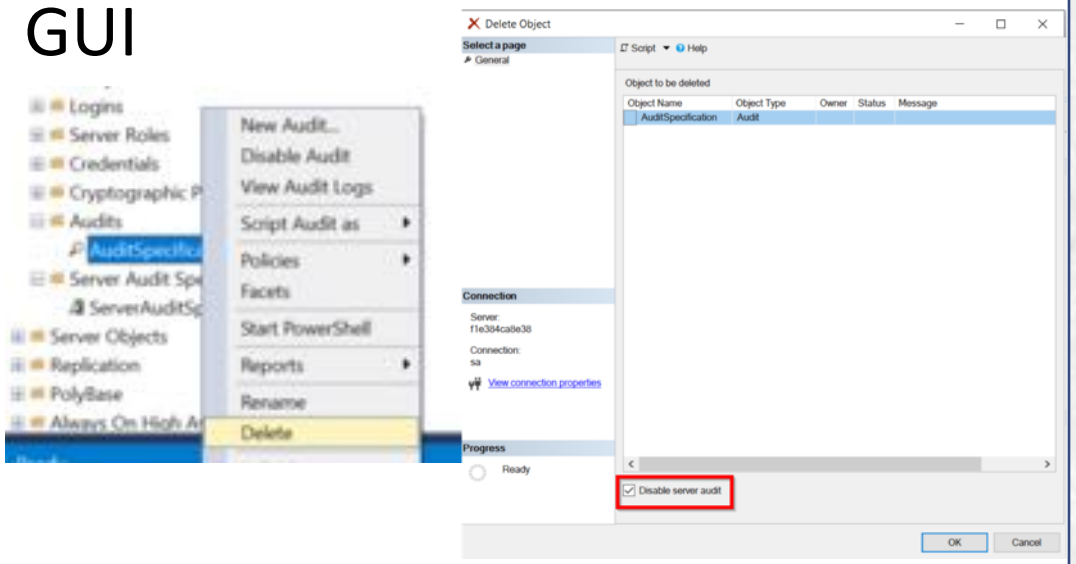


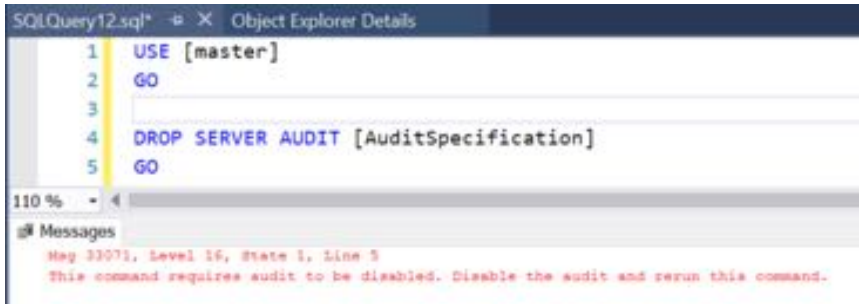
# DELETING AUDITS

Two ways to delete audits

## GUI




## Script



# STOPPING AUDITS

Two ways to stop audits

GUI


Script

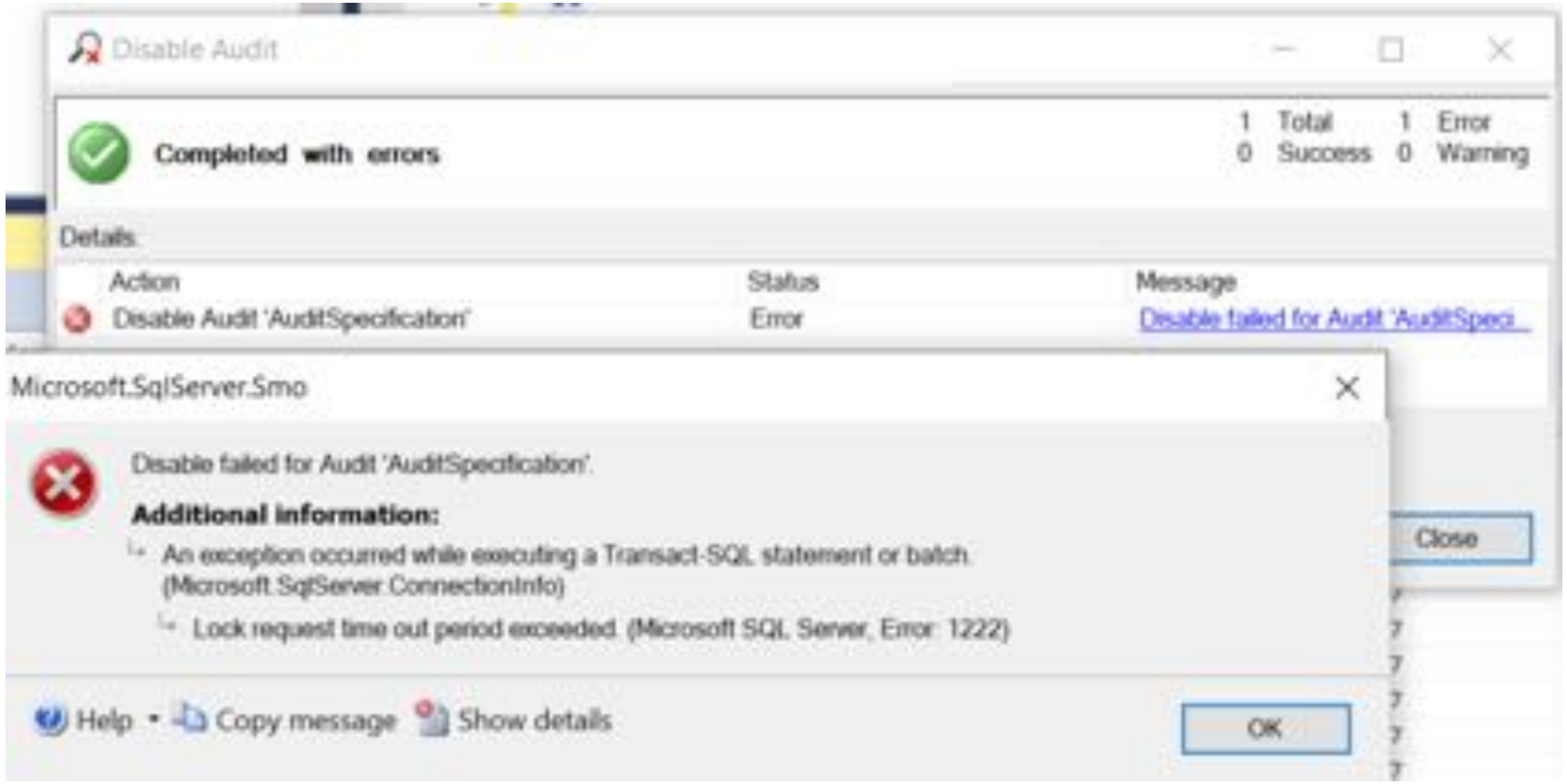
```
USE master;
ALTER SERVER AUDIT AuditSpecification
WITH (STATE = OFF);
```

```
USE master;
ALTER SERVER AUDIT SPECIFICATION
[ServerAuditSpecification]
WITH (STATE = OFF);
```

```
USE Auditing;
ALTER DATABASE AUDIT SPECIFICATION
[DatabaseAuditSpecification-auditing]
WITH (STATE = OFF);
```

# STOPPING AUDIT FAILURE

If you have long running queries preventing stopping audit



# MODIFYING AUDITS

Two ways to change audits

GUI


Script

```
1  USE [master]
2  GO
3  ALTER SERVER AUDIT [AuditSpecification]
4  TO FILE
5  (MAXSIZE = 100 MB)
6  GO
```

Messages

```
Msg 33071, Level 16, State 1, Line 3
This command requires audit to be disabled. Disable the audit and rerun this command.
```

# SQL SERVER AUDITING VIA GUI SUMMARY

You need two things to make this work:

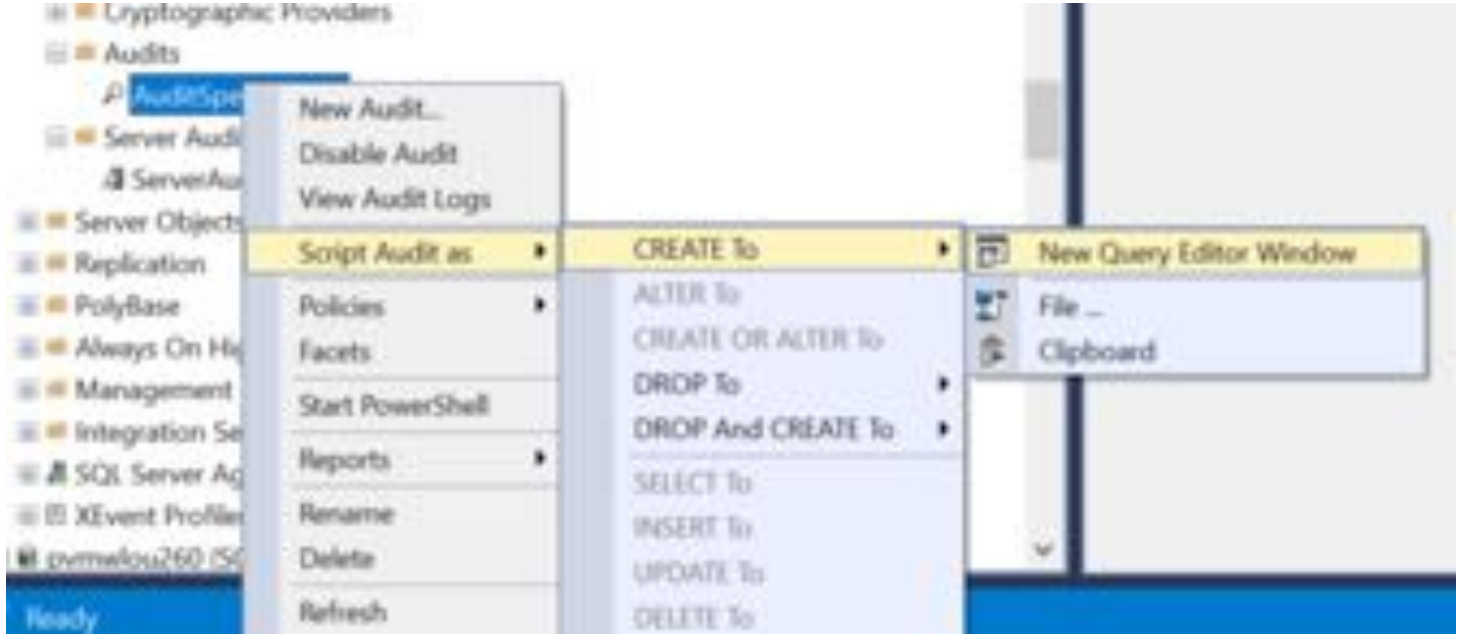
One audit specification (required)

And one of these things:

1. A server audit specification
2. A database audit specification

# SCRIPT OUT AUDITS

Scripting out audits



# CREATE AUDIT VIA SCRIPT

Creating an audit specification via script

```
USE [master]
GO
CREATE SERVER AUDIT [AuditSpecification]
TO FILE
(FILEPATH = N'E:\sqlaudit'
,MAXSIZE = 50 MB
,MAX_FILES = 4
,RESERVE_DISK_SPACE = OFF
) WITH (QUEUE_DELAY = 1000, ON_FAILURE = CONTINUE)
ALTER SERVER AUDIT [AuditSpecification] WITH (STATE = ON)
GO
```

# CREATE SERVER AUDIT VIA SCRIPT

## Creating a server audit specification via script

```
USE [master]
CREATE SERVER AUDIT SPECIFICATION [ServerAuditSpecification]
FOR SERVER AUDIT [AuditSpecification]
ADD (DATABASE_ROLE_MEMBER_CHANGE_GROUP),
ADD (SERVER_ROLE_MEMBER_CHANGE_GROUP),
ADD (AUDIT_CHANGE_GROUP),
ADD (DATABASE_PERMISSION_CHANGE_GROUP),
ADD (SCHEMA_OBJECT_PERMISSION_CHANGE_GROUP),
ADD (SERVER_OBJECT_PERMISSION_CHANGE_GROUP),
ADD (SERVER_PERMISSION_CHANGE_GROUP),
ADD (DATABASE_CHANGE_GROUP),
ADD (DATABASE_OBJECT_CHANGE_GROUP),
ADD (DATABASE_PRINCIPAL_CHANGE_GROUP),
ADD (SCHEMA_OBJECT_CHANGE_GROUP),
ADD (SERVER_OBJECT_CHANGE_GROUP),
ADD (SERVER_PRINCIPAL_CHANGE_GROUP),
ADD (SERVER_OPERATION_GROUP),
ADD (APPLICATION_ROLE_CHANGE_PASSWORD_GROUP),
ADD (LOGIN_CHANGE_PASSWORD_GROUP),
ADD (SERVER_STATE_CHANGE_GROUP),
ADD (DATABASE_OWNERSHIP_CHANGE_GROUP),
ADD (SCHEMA_OBJECT_OWNERSHIP_CHANGE_GROUP),
ADD (SERVER_OBJECT_OWNERSHIP_CHANGE_GROUP),
ADD (USER_CHANGE_PASSWORD_GROUP)
WITH (STATE = ON)
```

# CREATE DATABASE AUDIT VIA SCRIPT

## Creating a database audit specification via script

```
USE [auditing]
CREATE DATABASE AUDIT SPECIFICATION [DatabaseAuditSpecification_Auditing]
FOR SERVER AUDIT [AuditSpecification]
ADD (DATABASE_ROLE_MEMBER_CHANGE_GROUP),
ADD (AUDIT_CHANGE_GROUP),
ADD (DBCC_GROUP),
ADD (DATABASE_PERMISSION_CHANGE_GROUP),
ADD (DATABASE_OBJECT_PERMISSION_CHANGE_GROUP),
ADD (SCHEMA_OBJECT_PERMISSION_CHANGE_GROUP),
ADD (DATABASE_CHANGE_GROUP),
ADD (DATABASE_OBJECT_CHANGE_GROUP),
ADD (DATABASE_PRINCIPAL_CHANGE_GROUP),
ADD (SCHEMA_OBJECT_CHANGE_GROUP),
ADD (APPLICATION_ROLE_CHANGE_PASSWORD_GROUP),
ADD (DATABASE_OWNERSHIP_CHANGE_GROUP),
ADD (DATABASE_OBJECT_OWNERSHIP_CHANGE_GROUP),
ADD (SCHEMA_OBJECT_OWNERSHIP_CHANGE_GROUP),
ADD (USER_CHANGE_PASSWORD_GROUP)
WITH (STATE = ON)
```

# SQL SERVER AUDIT OBJECTS VIA SCRIPT

```
USE [master]
CREATE SERVER AUDIT [AuditSpecification_AuditingTables]
TO FILE
(FILEPATH = N'E:\sqlaudit\'
,MAXSIZE = 10 MB
,MAX_FILES = 10
,RESERVE_DISK_SPACE = OFF
) WITH (QUEUE_DELAY = 1000, ON_FAILURE = CONTINUE)
ALTER SERVER AUDIT [AuditSpecification_AuditingTables] WITH (STATE = ON)

USE [Auditing]
CREATE DATABASE AUDIT SPECIFICATION [DatabaseAuditSpecification_AuditingTables]
FOR SERVER AUDIT [AuditSpecification_AuditingTables]
ADD (INSERT ON OBJECT::[dbo].[testing] BY [public]),
ADD (EXECUTE ON OBJECT::[dbo].[SelectTestingTable] BY [public]),
ADD (SELECT ON OBJECT::[dbo].[TestingTop10] BY [public]),
ADD (DELETE ON SCHEMA::[dbo] BY [auditing]),
ADD (UPDATE ON DATABASE::[Auditing] BY [public])
WITH (STATE = ON)
```

**Be very careful auditing entire schemas or databases. They can overload your audit and/or server.**

# FILTERING SQL SERVER AUDIT

Filtering so you don't wind up with SQL Server built-in accounts or the account you use for monitoring filling up the audit data using WHERE clause

```
USE [master]
GO
CREATE SERVER AUDIT [AuditSpecification]
TO FILE
(FILEPATH = N'E:\sqlaudit\'
,MAXSIZE = 50 MB
,MAX_FILES = 4
,RESERVE_DISK_SPACE = OFF
) WITH (QUEUE_DELAY = 1000, ON_FAILURE = CONTINUE)
WHERE (server_principal_name <> 'monitoringserviceaccount'
AND server_principal_name <> 'builtinsqlserveraccount'
AND schema_name <> 'sys')
ALTER SERVER AUDIT [AuditSpecification] WITH (STATE = ON)
GO
```

# QUERYING AUDIT VIA SCRIPT

```
SELECT distinct DATEADD(mi, DATEPART(TZ, SYSDATETIMEOFFSET()), event_time) as event_time,
aa.name as audit_action,statement,succeeded, server_instance_name,
database_name, schema_name, session_server_principal_name, server_principal_name,
object_Name, file_name, client_ip, application_name, host_name, file_name
FROM sys.fn_get_audit_file ('/var/opt/mssql/data/audit/*.sqlaudit',default,default) af
INNER JOIN sys.dm_audit_actions aa ON aa.action_id = af.action_id
where  DATEADD(mi, DATEPART(TZ, SYSDATETIMEOFFSET()), event_time) > DATEADD(HOUR, -24, GETDATE())
order by DATEADD(mi, DATEPART(TZ, SYSDATETIMEOFFSET()), event_time) desc
```

| event_time | audit_action | statement | succeeded | server_instance_name | database_name | schema_name | session_server_princi |
|---|---|---|---|---|---|---|---|
| 2021-03-10 16:56:43.2172217 | VIEW SERVER STATE | SELECT se is_admin_endpoint AS N'AdminConnection', ... | 1 | ubuntusql1 | master | | sa |
| 2021-03-10 00:14:46.0174361 | ALTER | ALTER SERVER AUDIT SPECIFICATION [ServerAuditSpe... | 1 | ubuntusql1 | master | | sa |
| 2021-03-10 00:14:43.2910458 | ALTER | ALTER SERVER AUDIT SPECIFICATION [ServerAuditSpe... | 1 | ubuntusql1 | master | | sa |
| 2021-03-10 00:13:49.0498994 | DROP | DROP TABLE [dbo].[testing] | 1 | ubuntusql1 | testing | dbo | sa |
| 2021-03-10 00:13:12.5602091 | ALTER | ALTER SERVER AUDIT SPECIFICATION [ServerAuditSpe... | 1 | ubuntusql1 | master | | sa |
| 2021-03-10 00:12:47.8445646 | ADD MEMBER | ALTER ROLE [db_datawriter] ADD MEMBER [testing] | 1 | ubuntusql1 | testing | | sa |
| 2021-03-10 00:12:47.8364041 | ADD MEMBER | ALTER ROLE [db_datareader] ADD MEMBER [testing] | 1 | ubuntusql1 | testing | | sa |
| 2021-03-10 00:12:47.7993722 | CREATE | CREATE USER [testing] FOR LOGIN [testing] WITH DEFA... | 1 | ubuntusql1 | testing | | sa |
| 2021-03-10 00:12:44.9579663 | CREATE | CREATE LOGIN [testing] WITH PASSWORD=N'******', DEF... | 1 | ubuntusql1 | master | | sa |
| 2021-03-10 00:12:39.7804485 | CREATE | CREATE TABLE [dbo].[testing]([testing] [nchar](10) NUL... | 1 | ubuntusql1 | testing | dbo | sa |
| 2021-03-10 00:12:39.7763430 | ALTER | CREATE TABLE [dbo].[testing]([testing] [nchar](10) NUL... | 1 | ubuntusql1 | testing | | sa |
| 2021-03-10 00:12:38.0582305 | CREATE | CREATE DATABASE testing | 1 | ubuntusql1 | master | | sa |

# DISCLAIMER ON AUDITING

Be very careful how and what you audit

**You can overload or freeze up a production server**

Less is more

# SQL AUDITING SCRIPTS SUMMARY

Everything you can do in the GUI you can do via scripts

Easier to create on multiple servers

Easier to filter audit results with a query

# ANOTHER AUDITING METHOD

SQL Server also includes something called:

## Extended events

Audit what changes, but also audit other things in SQL Server like performance metrics

# SQL SERVER AUDITING DEMO

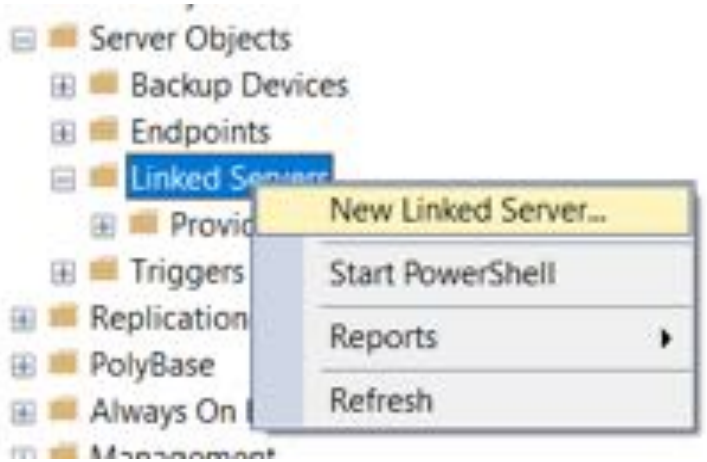
# AUDIT DATA REPORTING

Centralized audit database for easy querying and reporting on multiple servers' audit data

# CENTRALIZING AUDITING DATA

## Using linked servers

Each audited server will link to a centralized database server




## Using SQL Server Agent

Each audited server will send data to a central database server via SQL Agent job

Agent job scheduled hourly or on an interval of your choosing

# REPORTING VIA AGENT JOB

Agent jobs on centralized server:

- Send an email with the daily auditing results in HTML format
- Auditing cleanup to keep only 30 days

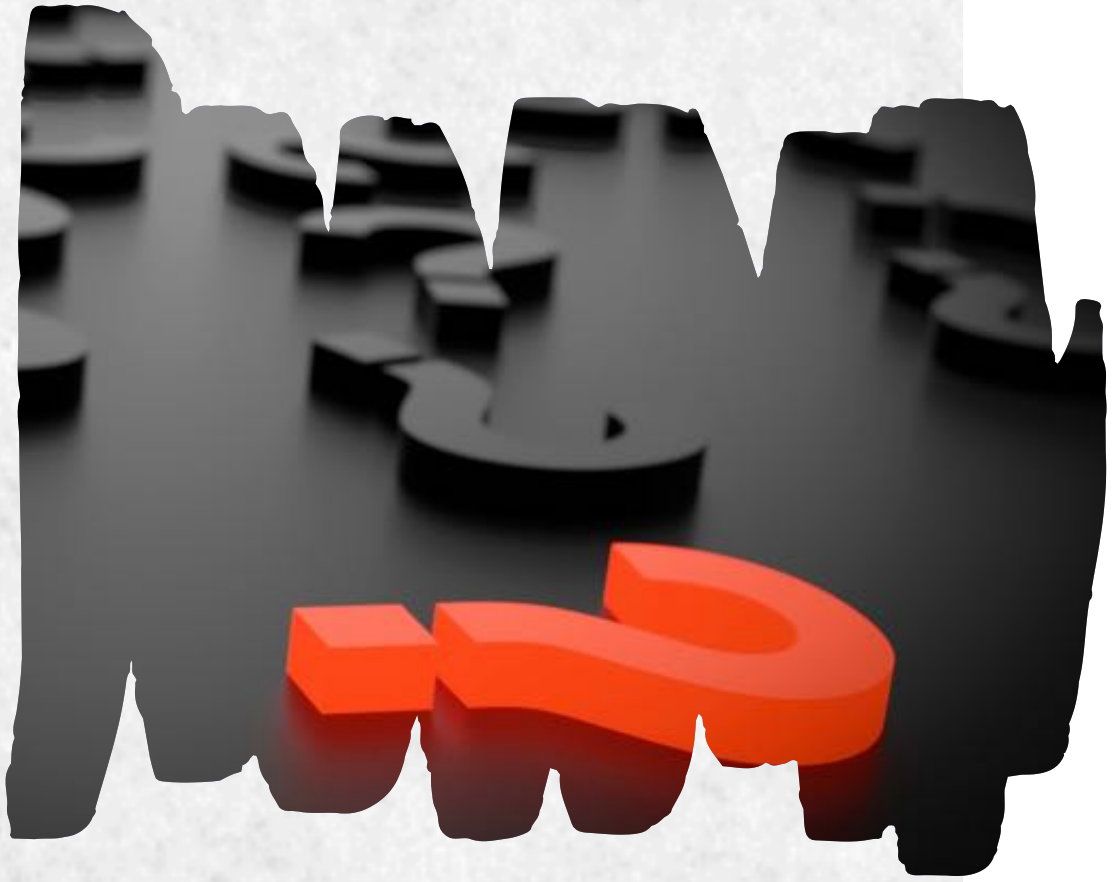
You also need database mail configured on your centralized server

# SAMPLE AUDIT FINDINGS REPORT

## SQL Server Auditing Findings

| Event Time | Audit Action | Partial Statement | Server | Database | Schema | Username | Successful |
|---|---|---|---|---|---|---|---|
| 03/05/21 4:27:01 PM | ALTER | ALTER SERVER ROLE [sysadmin] ADD MEMBER [domain\group] | Sql1 | master | | josephine | 1 |
| 03/05/21 4:08:58 PM | CREATE | CREATE LOGIN [domain\group] FROM | Sql1 | master | | josephine | 1 |
| 03/05/21 2:06:43 PM | ALTER | TRUNCATE TABLE [dbo].[tablename] | Sql2 | userdb | dbo | appuser | 0 |
| 03/05/21 1:27:00 PM | DROP | DROP DATABASE db | Sql3 | master | | sa | 1 |
| 03/05/21 12:27:00 PM | ALTER | ALTER VIEW [dbo].[tablename_view] AS SELECT | Sql4 | userdb | dbo | anotherappuser | 1 |

# CENTRALIZED AUDIT DATA SUMMARY



Centralized audit database for easy querying and reporting on multiple servers' audit data

Audited servers send data via agent jobs and linked servers to centralized server

Centralized server sends audit data via email daily or weekly depending on your reporting needs

# CLOUD SQL AUDITING OPTIONS

| Cloud solution | SQL Server Audit Available | Auditing differences |
|---|---|---|
| Azure SQL | No | Server and database audits via Azure portal |
| Azure SQL Managed Instance | Yes | Need to use cloud storage |
| Amazon Web Services RDS | Yes | Need to use cloud storage |
| Google Cloud | No | Cloud audit logs via Google portal |
| VMs | Yes | Same with the ability to save to disk |

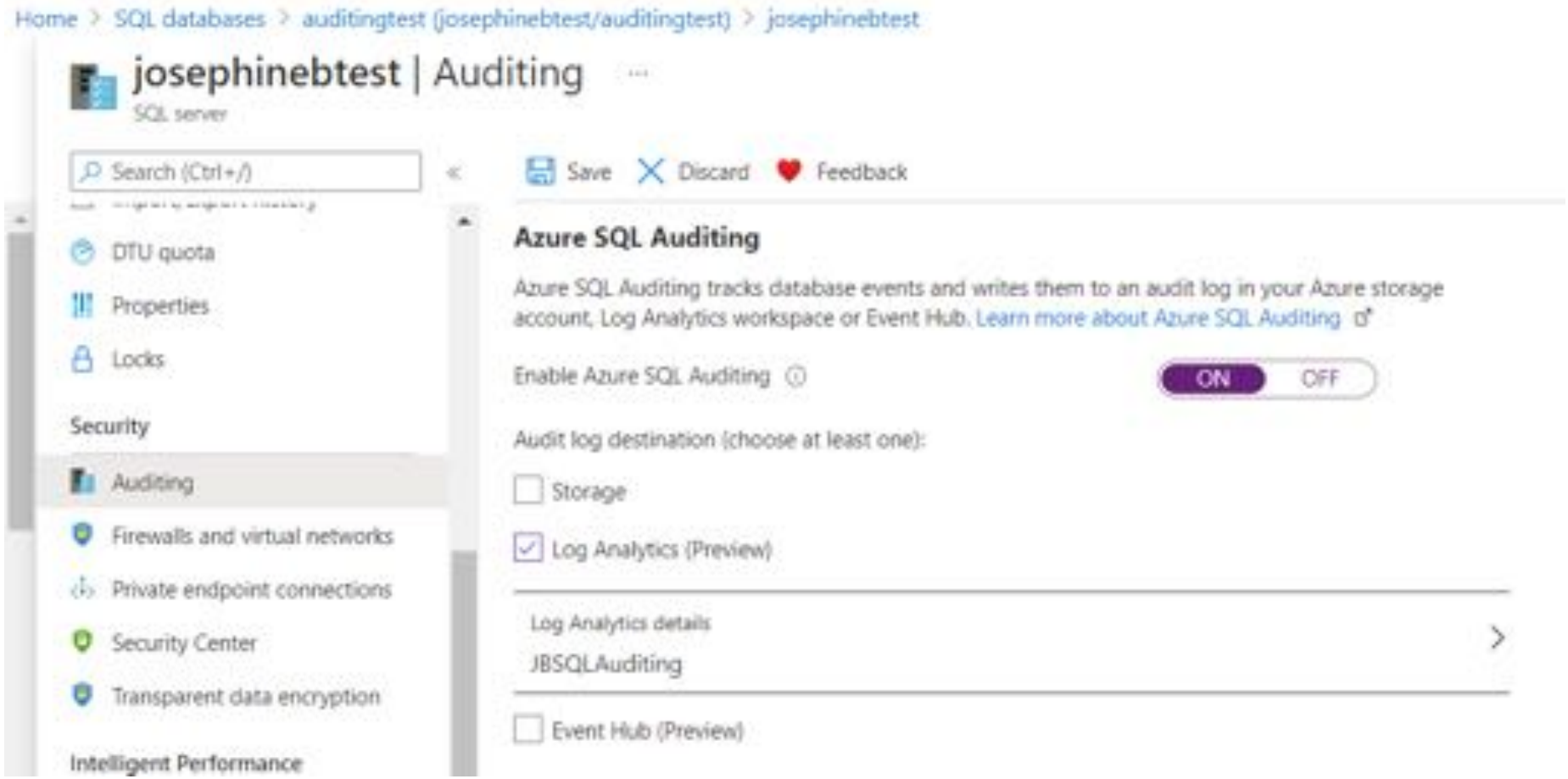
# AZURE SQL AUDITING


Audit at server and database level via the portal

Use these to see queries run by users on Azure SQL

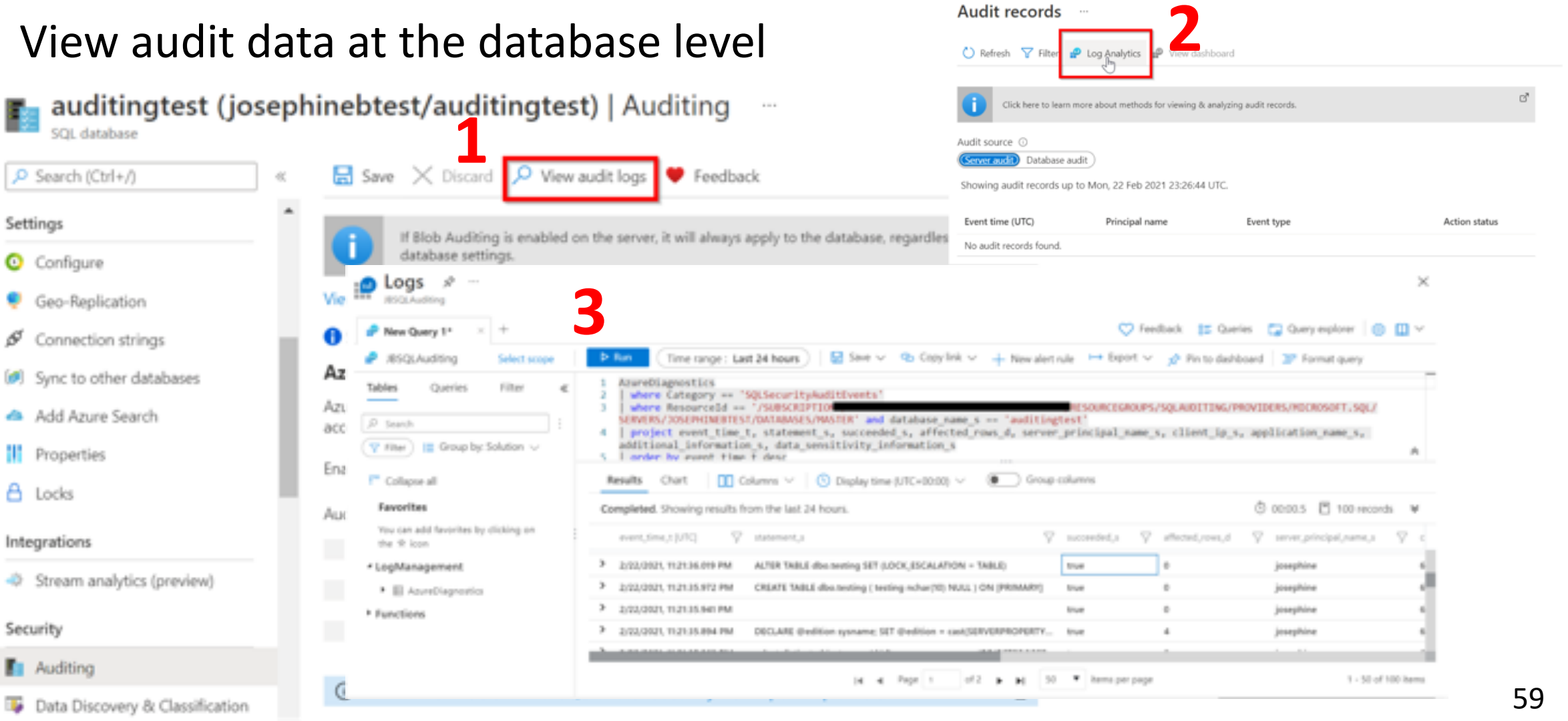
# SETUP AZURE SQL AUDITING

Enable auditing at the server level



# VIEW AZURE SQL AUDITING

View audit data at the database level



# CLOUD AUDITING SUMMARY

Each cloud provider has options for auditing database changes:

AWS, Azure Managed Instance, and VMs in the cloud are most like SQL Server auditing

Azure SQL has similar functionality in the portal

Google cloud has auditing capabilities in their portal

# SQL SERVER AUDIT REVIEW

One audit specification (required)

And a server audit specification and/or a database audit specification

Setup and query via GUI or scripts

**Remember to not audit so much that you can't stop the audit or easily query the data. You can overload or freeze up a production server**

# RESOURCES

SQL Server Audit Overview

https://docs.microsoft.com/en-us/sql/relational-databases/security/auditing/sql-server-audit-database-engine?view=sql-server-ver15

Querying SQL Server Audit file

https://docs.microsoft.com/en-us/sql/relational-databases/system-functions/sys-fn-get-audit-file-transact-sql?view=sql-server-ver15

Linked servers

https://docs.microsoft.com/en-us/sql/relational-databases/linked-servers/create-linked-servers-sql-server-database-engine?view=sql-server-ver15

SQL Agent jobs

https://docs.microsoft.com/en-us/sql/ssms/agent/create-a-job?view=sql-server-ver15

SQL Server Audit Server Actions

https://docs.microsoft.com/en-us/sql/relational-databases/security/auditing/sql-server-audit-action-groups-and-actions?view=sql-server-ver15#database-level-audit-action-groups

SQL Server Audit Database Actions

https://docs.microsoft.com/en-us/sql/relational-databases/security/auditing/sql-server-audit-action-groups-and-actions?view=sql-server-ver15

Azure SQL Auditing

https://docs.microsoft.com/en-us/azure/azure-sql/database/auditing-overview

Database mail

https://docs.microsoft.com/en-us/sql/relational-databases/database-mail/configure-database-mail?view=sql-server-ver15


# THANK YOU FOR ATTENDING

Contact me @hellosqlkitty

or visit me at sqlkitty.com

# EXTRAS

Some additional slides that didn’t fit into the presentation time slot, which include these topics:

- Auditing a specific user
- Auditing agent jobs
- Auditing SSIS
- Querying existing audit specifications

# SQL SERVER AUDITING A USER

## Audit specification

```
USE [master]
CREATE SERVER AUDIT [Audit_AuditingUser]
TO FILE
(FILEPATH = N'E:\sqlaudit\auditinguser\'
,MAXSIZE = 100 MB
,MAX_FILES = 4
,RESERVE_DISK_SPACE = OFF
) WITH (QUEUE_DELAY = 1000, ON_FAILURE = CONTINUE)
WHERE ([server_principal_name]='auditing' AND [schema_name]<>'sys')
ALTER SERVER AUDIT [Audit-AuditingUser] WITH (STATE = ON)
```

## Server audit specification

```
USE [master]
CREATE SERVER AUDIT SPECIFICATION
[ServerAudit_Auditinguser]
FOR SERVER AUDIT [Audit-AuditingUser]
ADD (DATABASE_OBJECT_ACCESS_GROUP),
ADD (SCHEMA_OBJECT_ACCESS_GROUP),
ADD (DATABASE_ROLE_MEMBER_CHANGE_GROUP),
ADD (SERVER_ROLE_MEMBER_CHANGE_GROUP),
ADD (AUDIT_CHANGE_GROUP),
ADD (DATABASE_PERMISSION_CHANGE_GROUP),
ADD (SCHEMA_OBJECT_PERMISSION_CHANGE_GROUP),
ADD (SERVER_OBJECT_PERMISSION_CHANGE_GROUP),
ADD (SERVER_PERMISSION_CHANGE_GROUP),
ADD (DATABASE_CHANGE_GROUP),
ADD (DATABASE_OBJECT_CHANGE_GROUP),
ADD (DATABASE_PRINCIPAL_CHANGE_GROUP),
ADD (SCHEMA_OBJECT_CHANGE_GROUP),
ADD (SERVER_OBJECT_CHANGE_GROUP),
ADD (SERVER_PRINCIPAL_CHANGE_GROUP),
ADD (SERVER_OPERATION_GROUP),
ADD (APPLICATION_ROLE_CHANGE_PASSWORD_GROUP),
ADD (LOGIN_CHANGE_PASSWORD_GROUP),
ADD (SERVER_STATE_CHANGE_GROUP),
ADD (DATABASE_OWNERSHIP_CHANGE_GROUP),
ADD (SCHEMA_OBJECT_OWNERSHIP_CHANGE_GROUP),
ADD (SERVER_OBJECT_OWNERSHIP_CHANGE_GROUP),
ADD (USER_CHANGE_PASSWORD_GROUP)
WITH (STATE = ON)
```

**Be very careful with these audit actions**

**They can overload your audit and/or server**

# SQL SERVER AUDITING AGENT JOBS

Added to the database audit specification for MSDB

```
USE [msdb]
CREATE DATABASE AUDIT SPECIFICATION [DatabaseAuditSpecification_MSDB]
FOR SERVER AUDIT [AuditSpecification]
ADD (EXECUTE ON OBJECT::[dbo].[sp_add_jobstep] BY [public]),
ADD (EXECUTE ON OBJECT::[dbo].[sp_delete_jobstep] BY [public]),
ADD (DELETE ON OBJECT::[dbo].[sysjobs] BY [public]),
ADD (INSERT ON OBJECT::[dbo].[sysjobs] BY [public]),
ADD (UPDATE ON OBJECT::[dbo].[sysjobs] BY [public]),
ADD (EXECUTE ON OBJECT::[dbo].[sp_add_jobschedule] BY [public]),
ADD (EXECUTE ON OBJECT::[dbo].[sp_delete_jobschedule] BY [public]),
ADD (EXECUTE ON OBJECT::[dbo].[sp_add_job] BY [public]),
ADD (EXECUTE ON OBJECT::[dbo].[sp_update_job] BY [public]),
ADD (EXECUTE ON OBJECT::[dbo].[sp_delete_job] BY [public])
WITH (STATE = ON)
```

# SQL SERVER AUDITING SSIS

Added to the database audit specification for SSISDB

```
USE [SSISDB]
ALTER DATABASE AUDIT SPECIFICATION [DatabaseAuditSpecification_SSISDB]
FOR SERVER AUDIT [AuditSpecification]
ADD (DELETE ON OBJECT::[internal].[projects] BY [public]),
ADD (INSERT ON OBJECT::[internal].[projects] BY [public]),
ADD (UPDATE ON OBJECT::[internal].[projects] BY [public]),
ADD (DELETE ON OBJECT::[internal].[packages] BY [public]),
ADD (INSERT ON OBJECT::[internal].[packages] BY [public]),
ADD (UPDATE ON OBJECT::[internal].[packages] BY [public]),
ADD (DELETE ON OBJECT::[internal].[folders] BY [public]),
ADD (INSERT ON OBJECT::[internal].[folders] BY [public]),
ADD (UPDATE ON OBJECT::[internal].[folders] BY [public])
WITH (STATE = ON)
```

# AUDIT LIST QUERY

Returns listing of audit specifications

```
select sfa.audit_id, sfa.name, sfa.is_state_enabled, sfa.create_date, sfa.modify_date,
sfa.type_desc, sfa.queue_delay, sfa.max_file_size, sfa.max_rollover_files,
sfa.max_files, sfa.log_file_path, sfa.log_file_name
from sys.server_file_audits sfa
```

| | audit_id | name | is_state_enabled | create_date | modify_date | type_desc | queue_delay | max_file_size | max_rollover_files | max_files | l |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 65540 | AuditSpecification | 0 | 2021-02-12 23:14:58.880 | 2021-02-12 23:14:58.880 | FILE | 1000 | 500 | 2147483647 | 4 | |
| 2 | 65541 | AuditSpecification_AuditingTables | 1 | 2021-02-18 00:18:43.743 | 2021-02-18 00:18:43.743 | FILE | 1000 | 10 | 2147483647 | 10 | |

# SERVER AUDIT LIST QUERY

## Returns listing of server audit specifications

```
select sfa.name, sas.name, sas.create_date, sas.modify_date, sas.is_state_enabled,
sasd.audit_action_name
from sys.server_file_audits sfa
left join sys.dm_server_audit_status dsas
on sfa.audit_id = dsas.audit_id
left join sys.server_audit_specifications sas
on sfa.audit_id = sas.server_specification_id
left join sys.server_audit_specification_details sasd
on sas.server_specification_id = sasd.server_specification_id
```

| | name | name | create_date | modify_date | is_state_enabled | audit_action_name |
|---|---|---|---|---|---|---|
| 1 | AuditSpecification | ServerAuditSpecification | 2021-02-12 23:19:27.403 | 2021-02-12 23:19:27.403 | 0 | DATABASE_ROLE_MEMBER_CHANGE_GROUP |
| 2 | AuditSpecification | ServerAuditSpecification | 2021-02-12 23:19:27.403 | 2021-02-12 23:19:27.403 | 0 | SERVER_ROLE_MEMBER_CHANGE_GROUP |
| 3 | AuditSpecification | ServerAuditSpecification | 2021-02-12 23:19:27.403 | 2021-02-12 23:19:27.403 | 0 | AUDIT_CHANGE_GROUP |
| 4 | AuditSpecification | ServerAuditSpecification | 2021-02-12 23:19:27.403 | 2021-02-12 23:19:27.403 | 0 | DATABASE_PERMISSION_CHANGE_GROUP |
| 5 | AuditSpecification | ServerAuditSpecification | 2021-02-12 23:19:27.403 | 2021-02-12 23:19:27.403 | 0 | SCHEMA_OBJECT_PERMISSION_CHANGE_G... |
| 6 | AuditSpecification | ServerAuditSpecification | 2021-02-12 23:19:27.403 | 2021-02-12 23:19:27.403 | 0 | SERVER_OBJECT_PERMISSION_CHANGE_G... |
| 7 | AuditSpecification | ServerAuditSpecification | 2021-02-12 23:19:27.403 | 2021-02-12 23:19:27.403 | 0 | SERVER_PERMISSION_CHANGE_GROUP |
| 8 | AuditSpecification | ServerAuditSpecification | 2021-02-12 23:19:27.403 | 2021-02-12 23:19:27.403 | 0 | DATABASE_CHANGE_GROUP |

# DATABASE AUDIT LIST QUERY

## Returns listing of database audit specifications

```
select sfa.name, das.name, das.create_date, das.modify_date, das.is_state_enabled,
dasd.audit_action_name, dasd.class_desc
from sys.server_file_audits sfa
left join sys.database_audit_specifications das
on sfa.audit_guid = das.audit_guid
left join sys.database_audit_specification_details dasd
on das.database_specification_id = dasd.database_specification_id
```

| | name | name | create_date | modify_date | is_state_enabled | audit_action_name | class_desc |
|---|---|---|---|---|---|---|---|
| 10 | AuditSpecification | DatabaseAuditSpecification-auditing | 2021-02-13 00:04:50.897 | 2021-02-13 00:04:50.897 | 1 | SCHEMA_OBJECT_CHANGE_GROUP | DATABASE |
| 11 | AuditSpecification | DatabaseAuditSpecification-auditing | 2021-02-13 00:04:50.897 | 2021-02-13 00:04:50.897 | 1 | APPLICATION_ROLE_CHANGE_PASSWORD_... | DATABASE |
| 12 | AuditSpecification | DatabaseAuditSpecification-auditing | 2021-02-13 00:04:50.897 | 2021-02-13 00:04:50.897 | 1 | DATABASE_OWNERSHIP_CHANGE_GROUP | DATABASE |
| 13 | AuditSpecification | DatabaseAuditSpecification-auditing | 2021-02-13 00:04:50.897 | 2021-02-13 00:04:50.897 | 1 | DATABASE_OBJECT_OWNERSHIP_CHANGE... | DATABASE |
| 14 | AuditSpecification | DatabaseAuditSpecification-auditing | 2021-02-13 00:04:50.897 | 2021-02-13 00:04:50.897 | 1 | SCHEMA_OBJECT_OWNERSHIP_CHANGE_G... | DATABASE |
| 15 | AuditSpecification | DatabaseAuditSpecification-auditing | 2021-02-13 00:04:50.897 | 2021-02-13 00:04:50.897 | 1 | USER_CHANGE_PASSWORD_GROUP | DATABASE |