GROUPBY 2021

OCT 26-27

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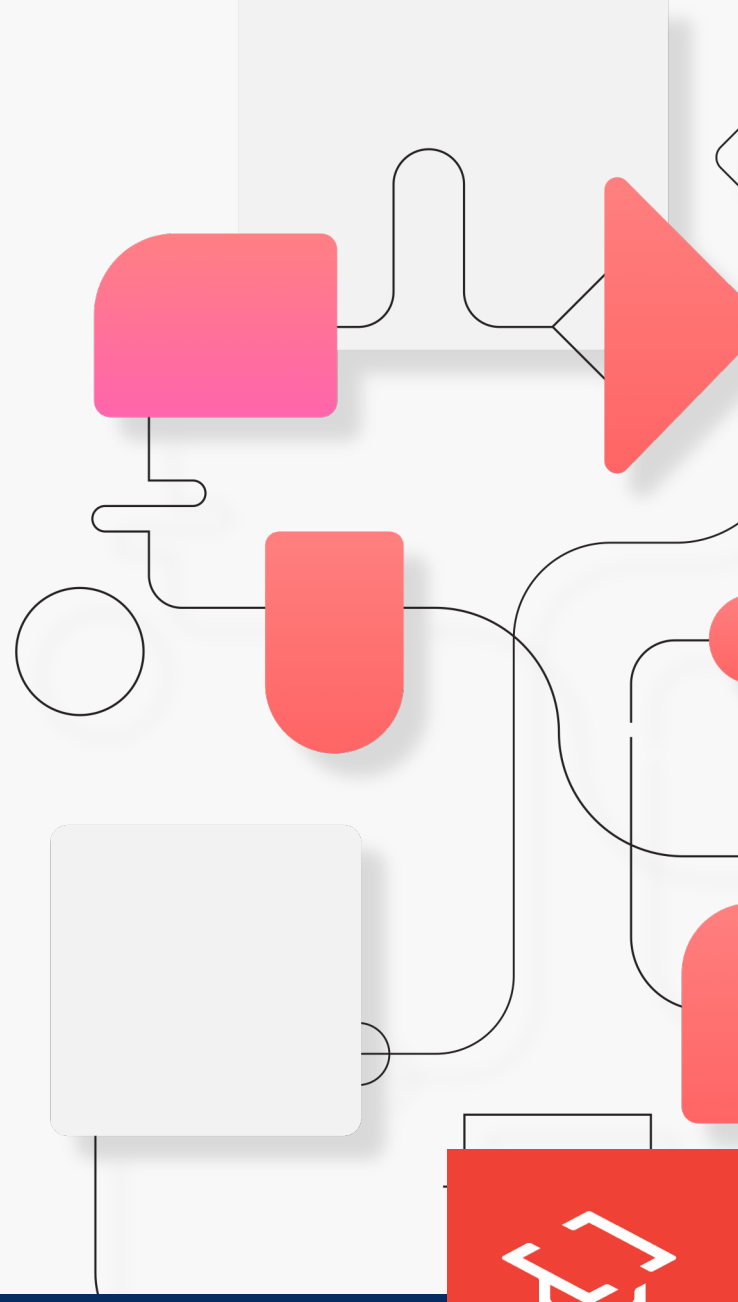

The Quick Version

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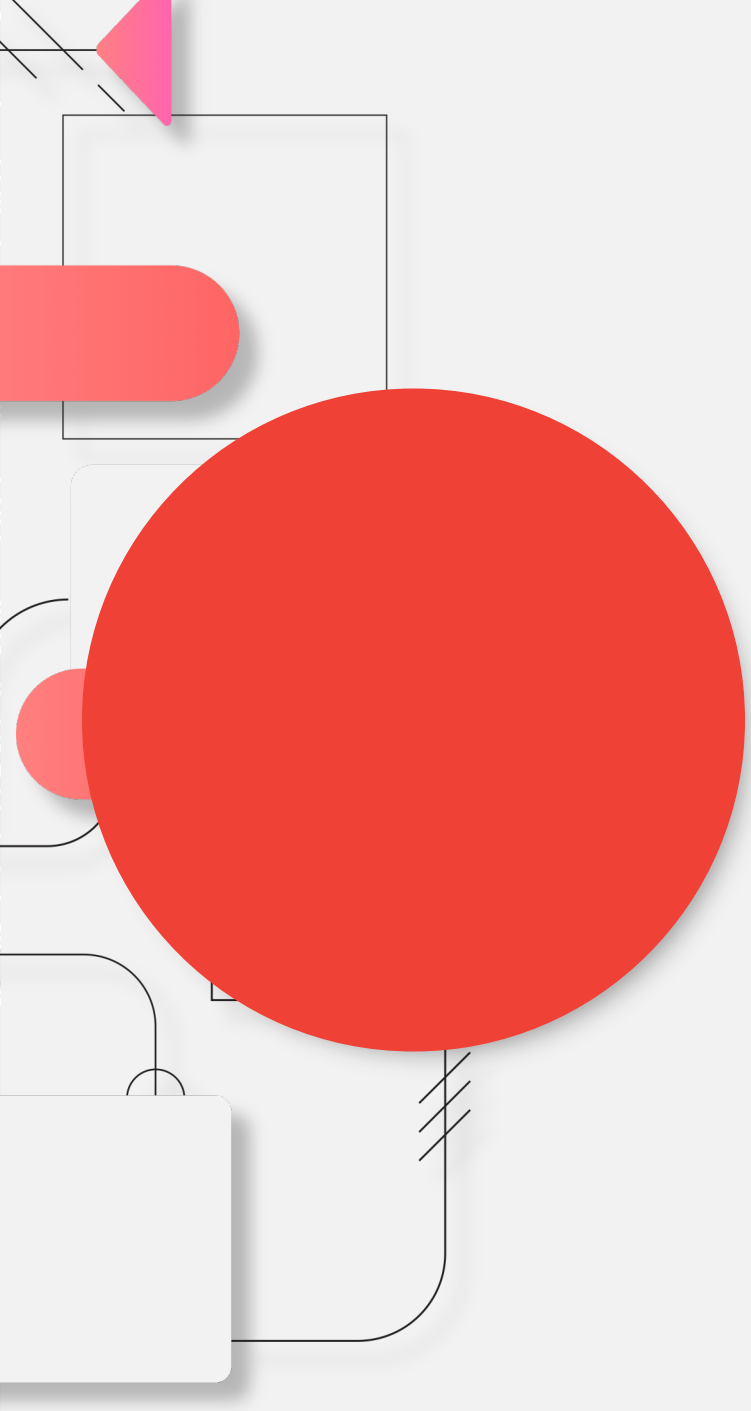
Auditing SQL Server:

Extended Events vs SQL Server Audit



Josephine Bush

Senior Database Adminstirator

sqlkitty.com

https://twitter.com/hellosqlkitty

Over 10 years of experience as a Database Administrator. Microsoft Certified Solutions Expert: Data Management and Analytics. BS in Information Technology, an MBA in IT Management, and an MS in Data Analytics. Author of Learn SQL Database Programming published by Packt in May 2020.

AGENDA

Why use auditing?

Problems you can solve

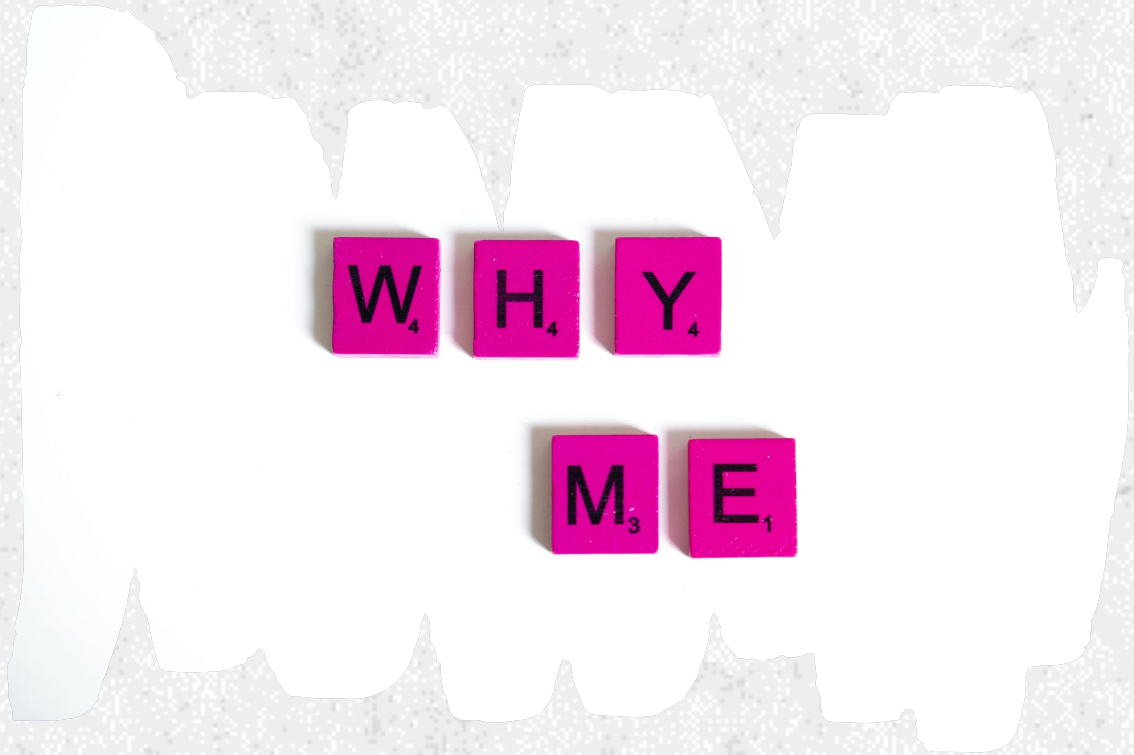
Extended events vs SQL

Server Audit:

- Pros and cons
- Use cases

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!

DISCLAIMER ON AUDITING

Be very careful how and what you audit

You can overload or freeze up a production server

Less is more

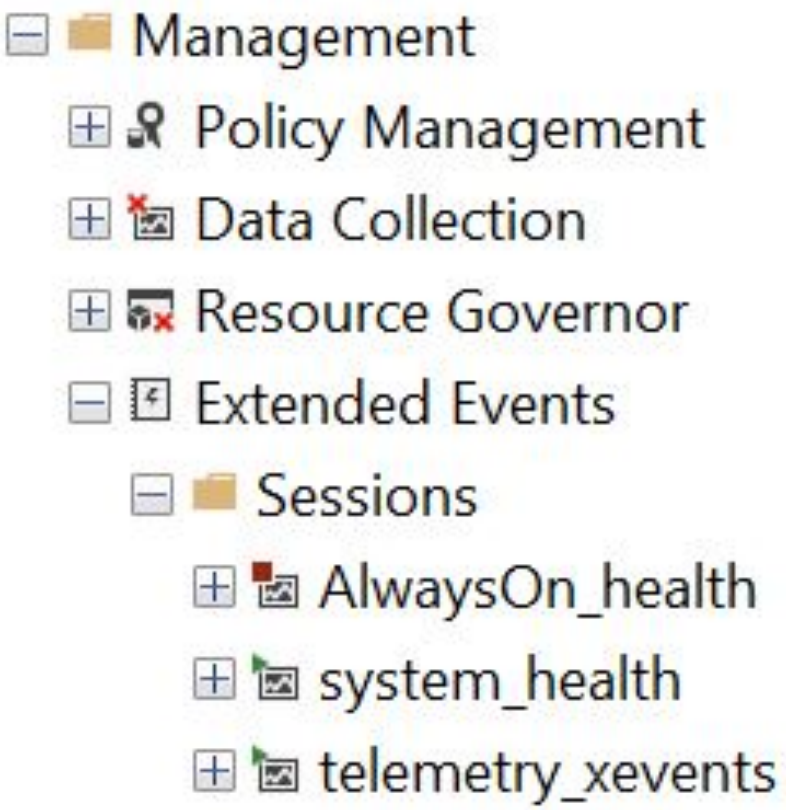
EXTENDED EVENTS (XEVENTS)

Lightweight and flexible

Good for monitoring and auditing

Collect information for troubleshooting and performance

Replacement for SQL Server Profiler and SQL Trace deprecated features



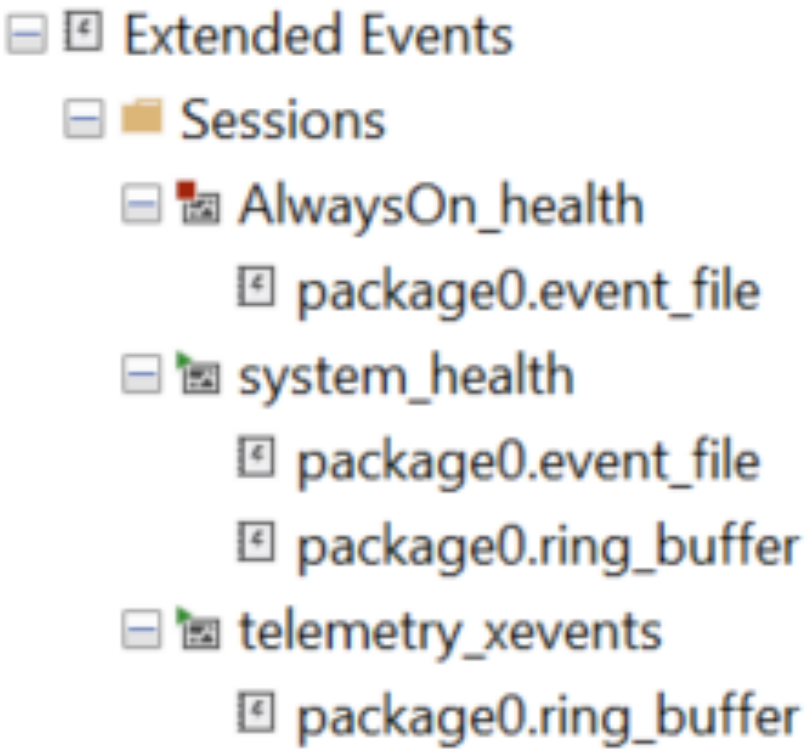
EXTENDED EVENTS AVAILABILITY

SQL Server Extended Events feature was introduced in SQL Server 2008

Graphical interface added in SQL Server 2012

XEVENTS DEFAULT SESSIONS

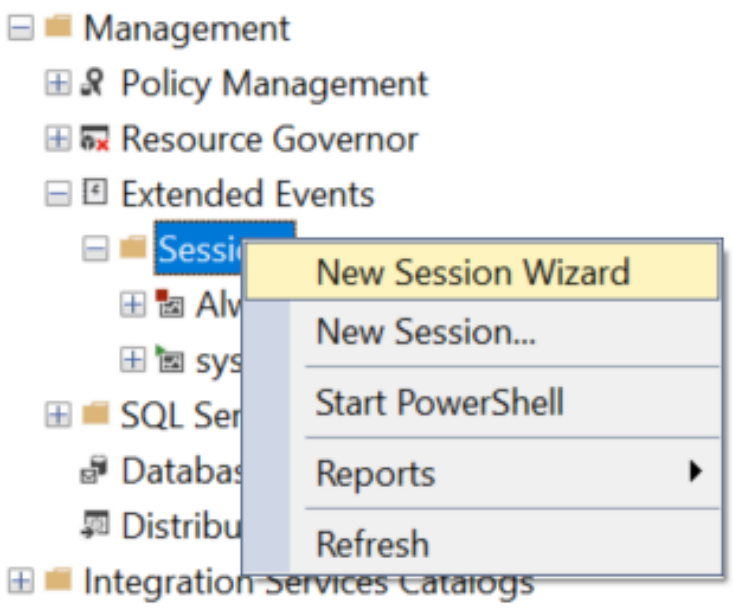
Come with SQL Server by default



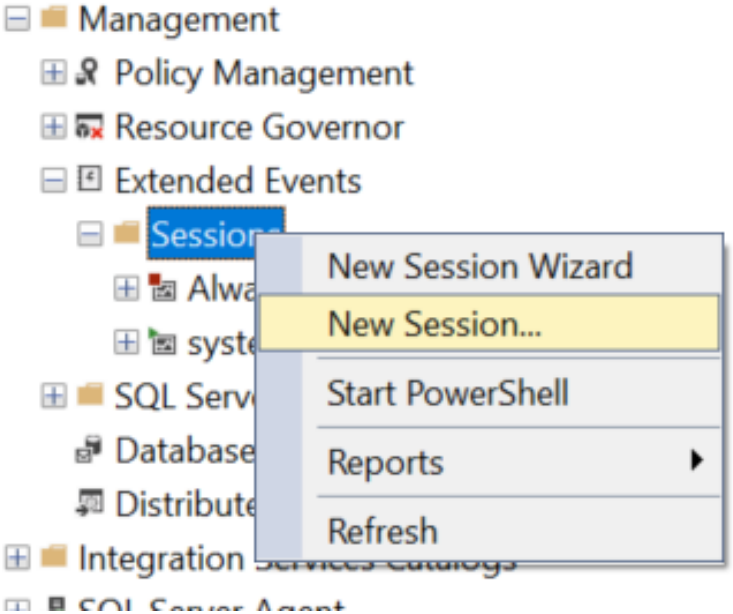
CREATE XEVENTS VIA GUI

Configure with the GUI in SSMS

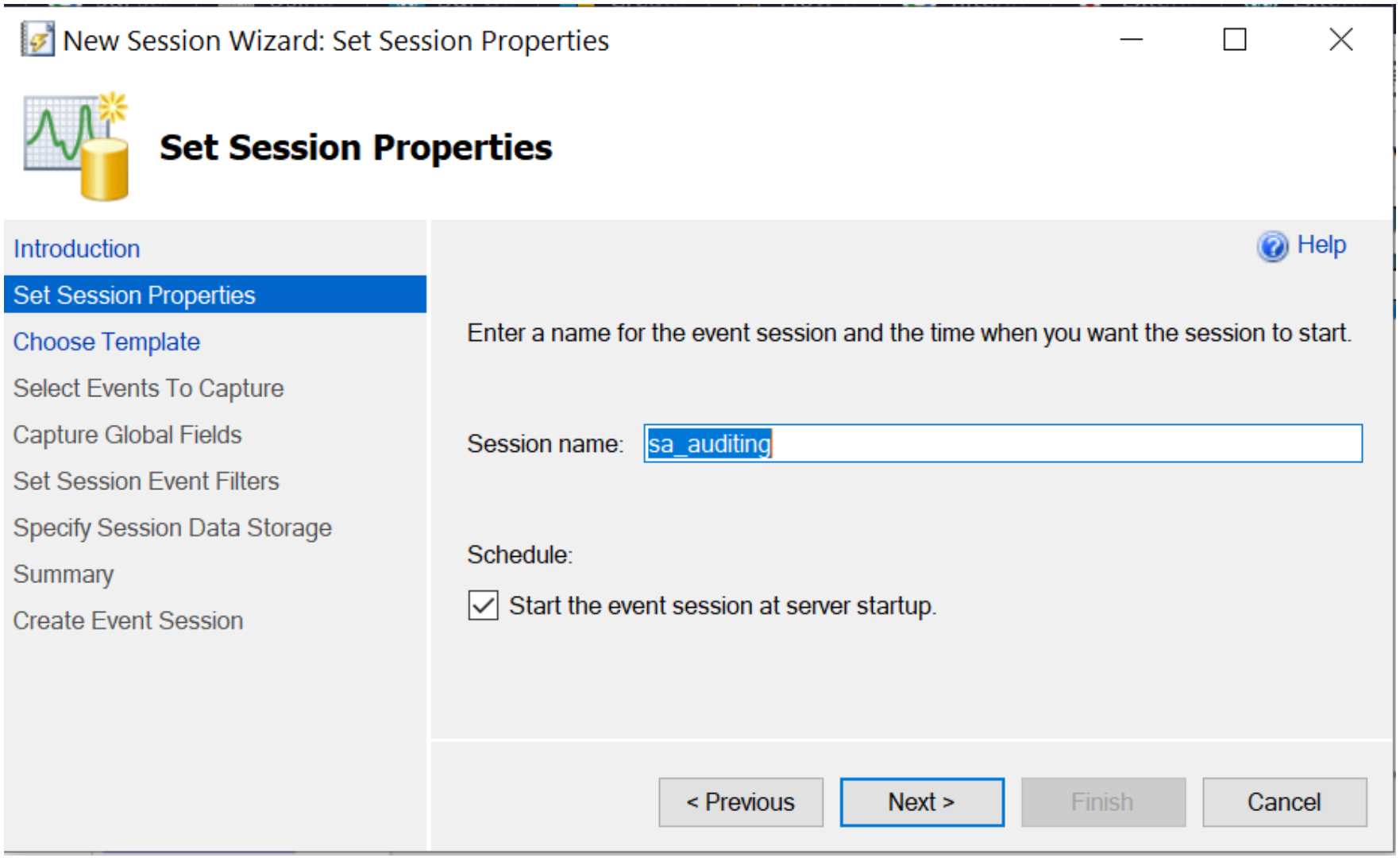
New Session Wizard option



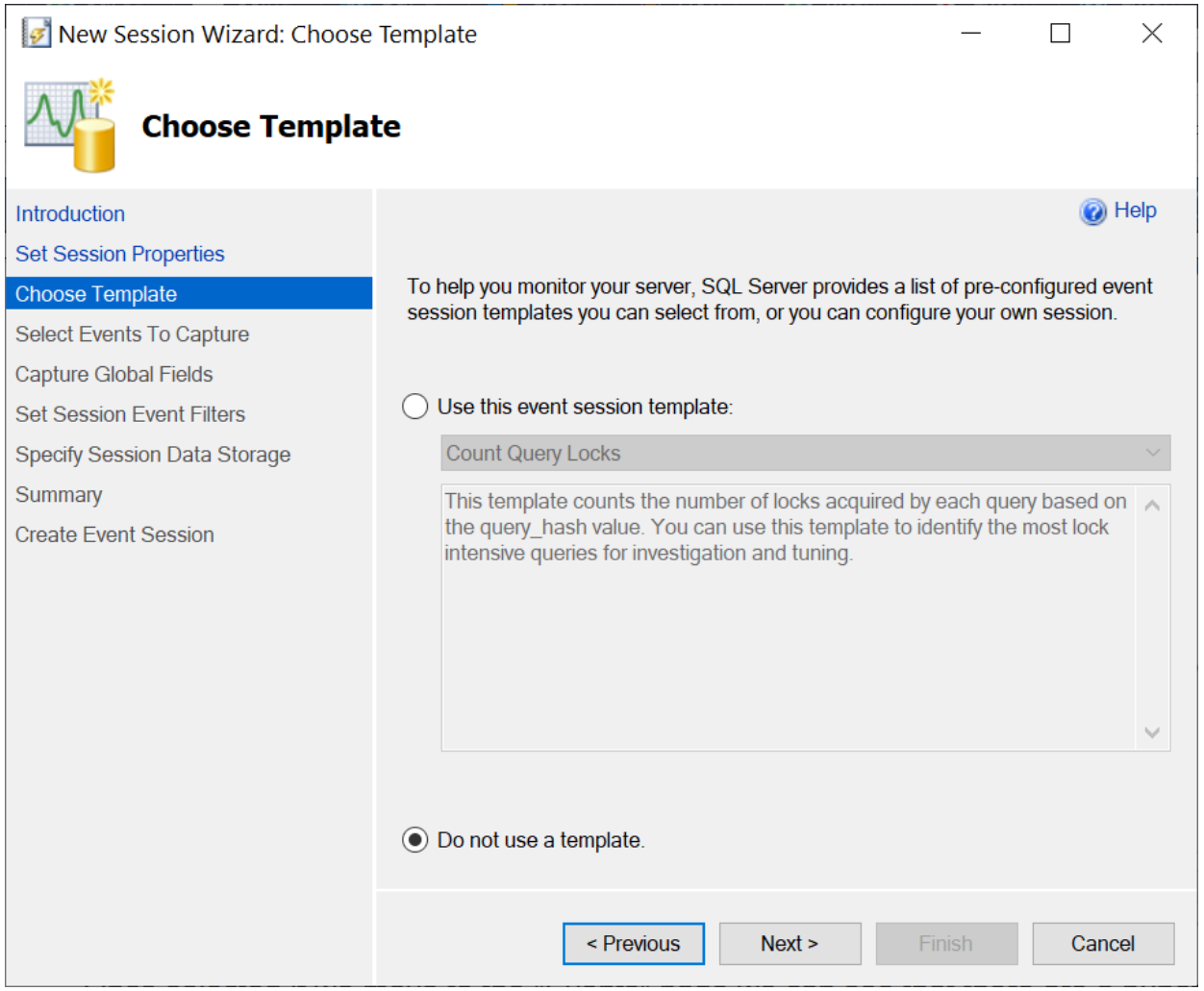
New Session option

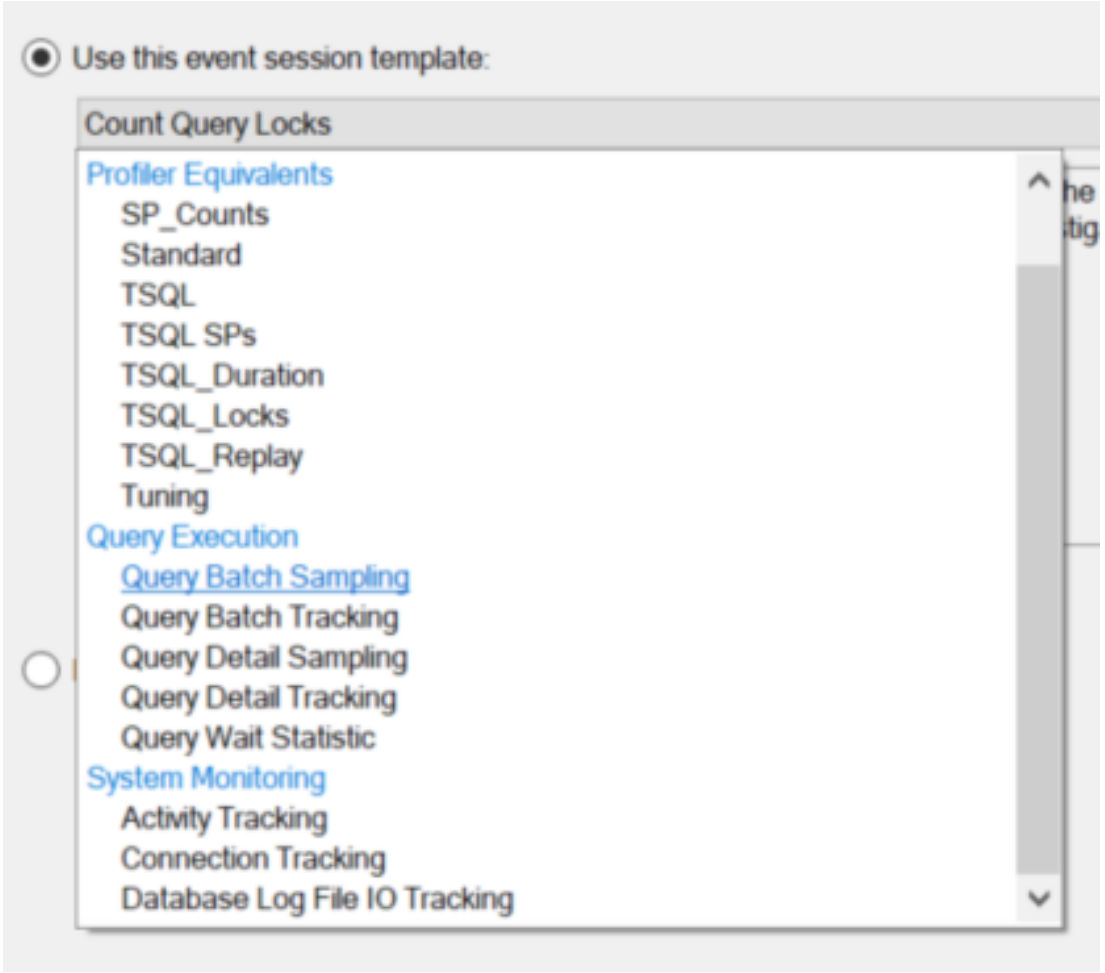


XEVENTS NAMING

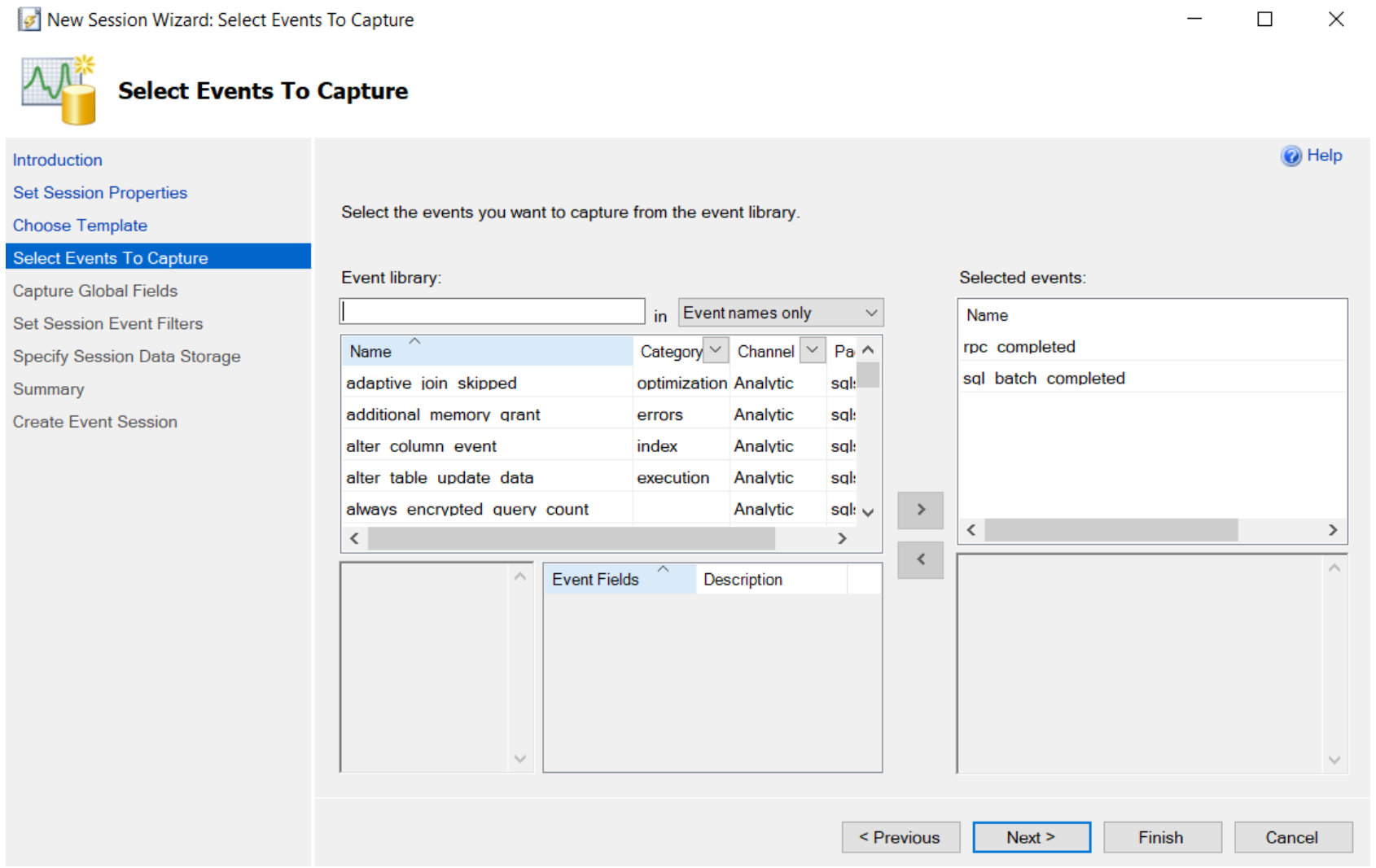


XEVENTS TEMPLATES





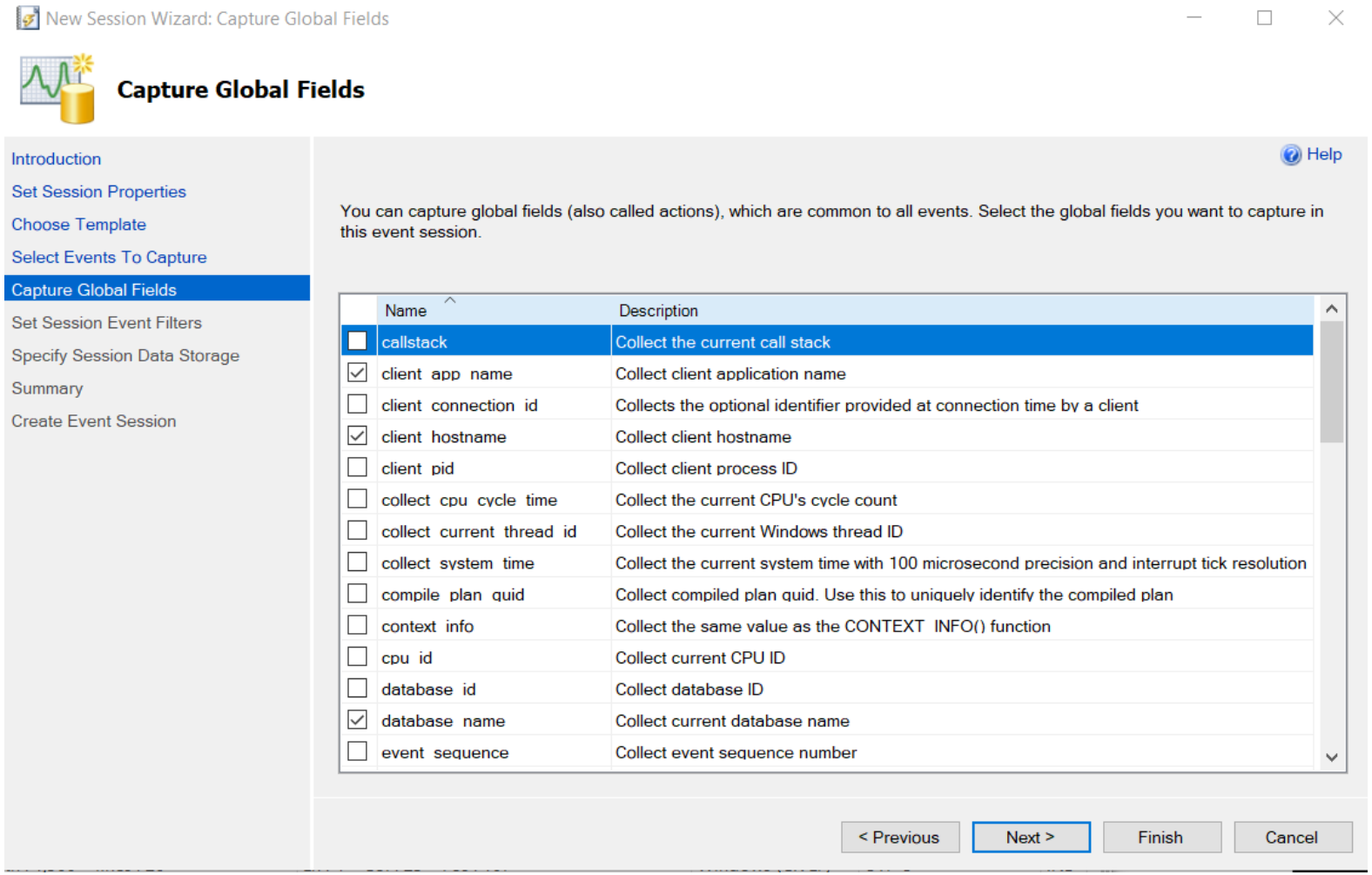
XEVENTS SELECT EVENTS



When auditing with xevents I use these events:

rpc_completed
sql_batch_completed

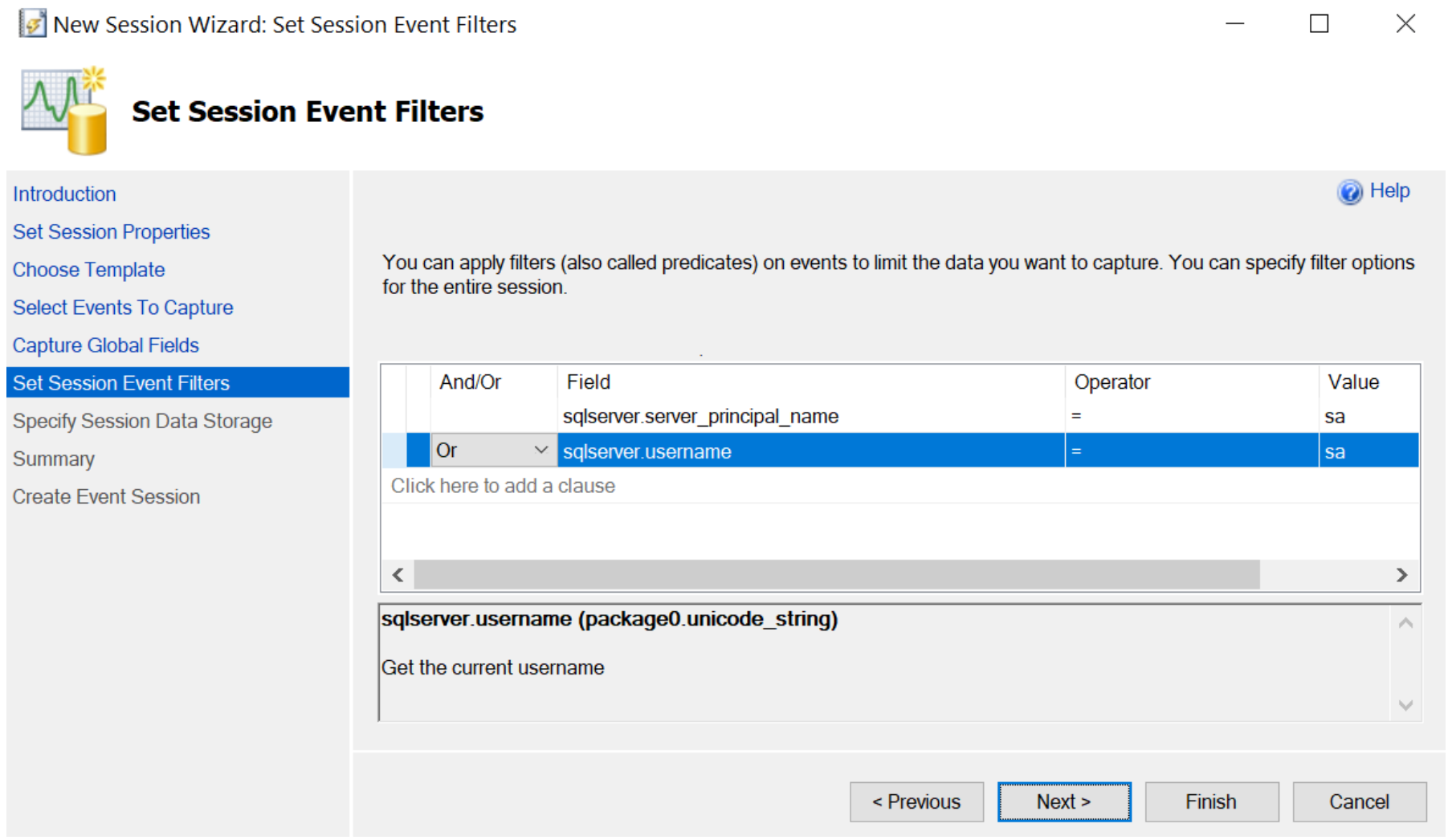
XEVENTS GLOBAL FIELDS



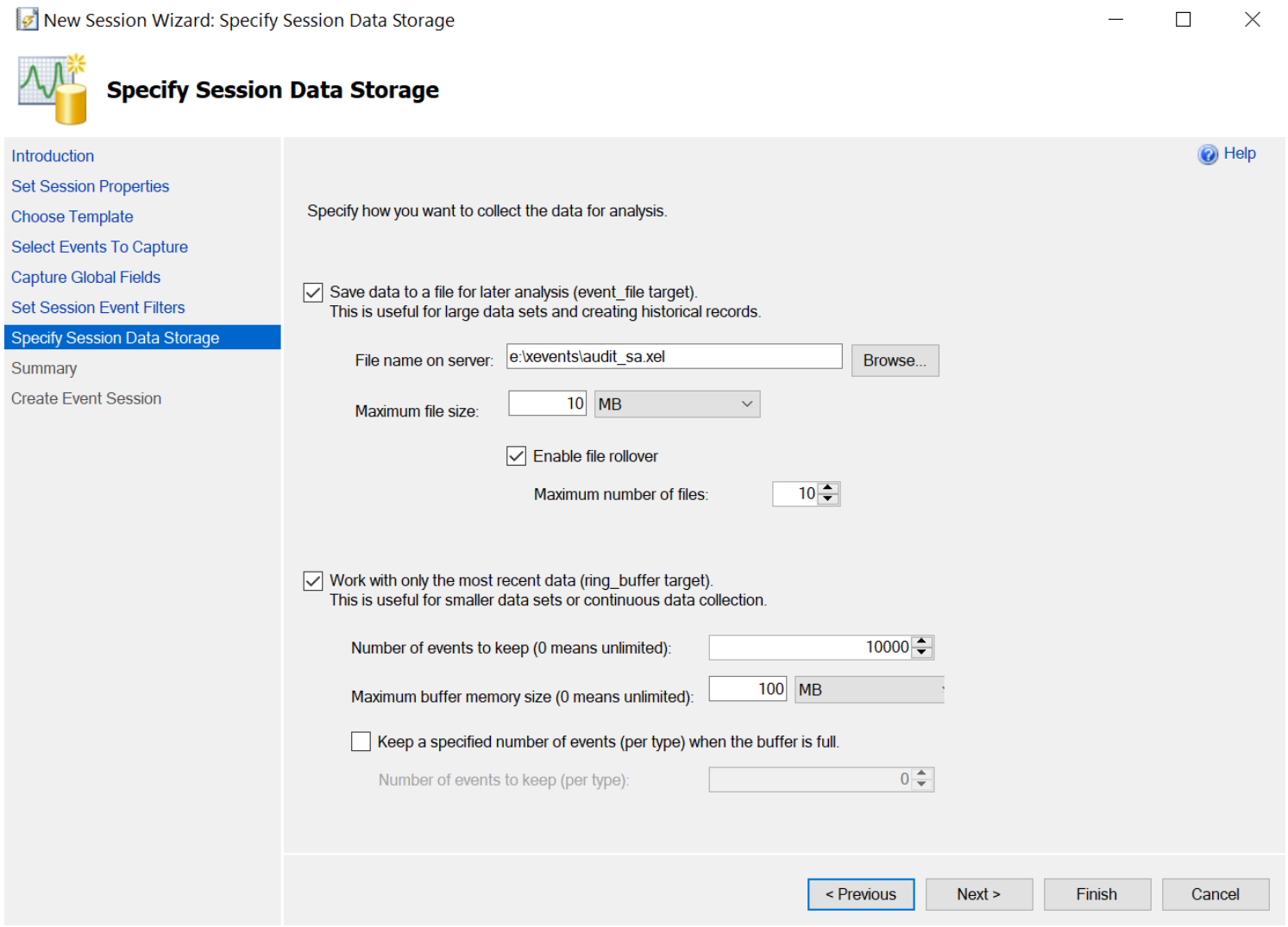
When auditing with xevents I use these global fields:

client_app_name
client_hostname
database_name
server_instance_name
server_principal_name
sql_text

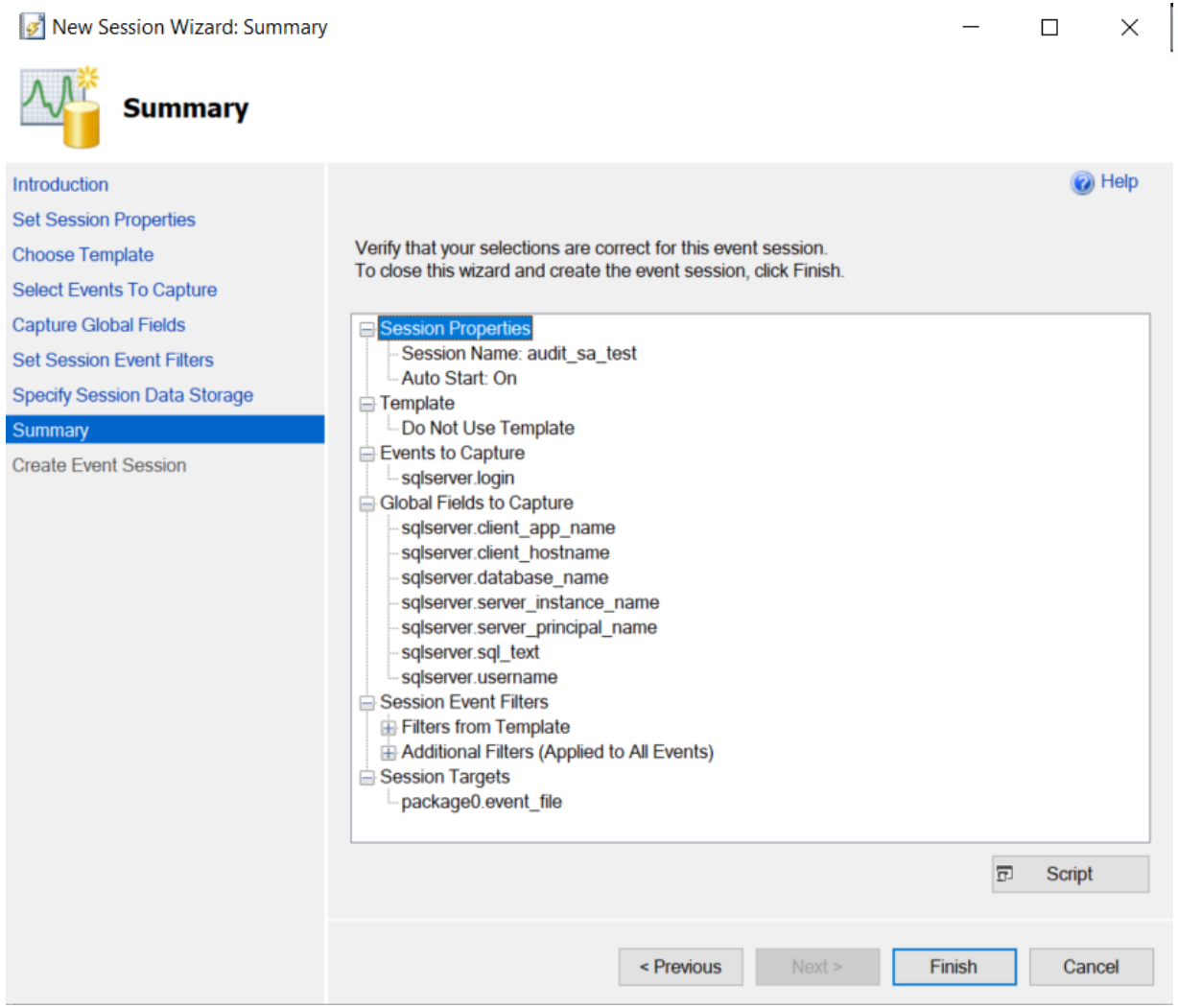
XEVENTS APPLYING FILTERS



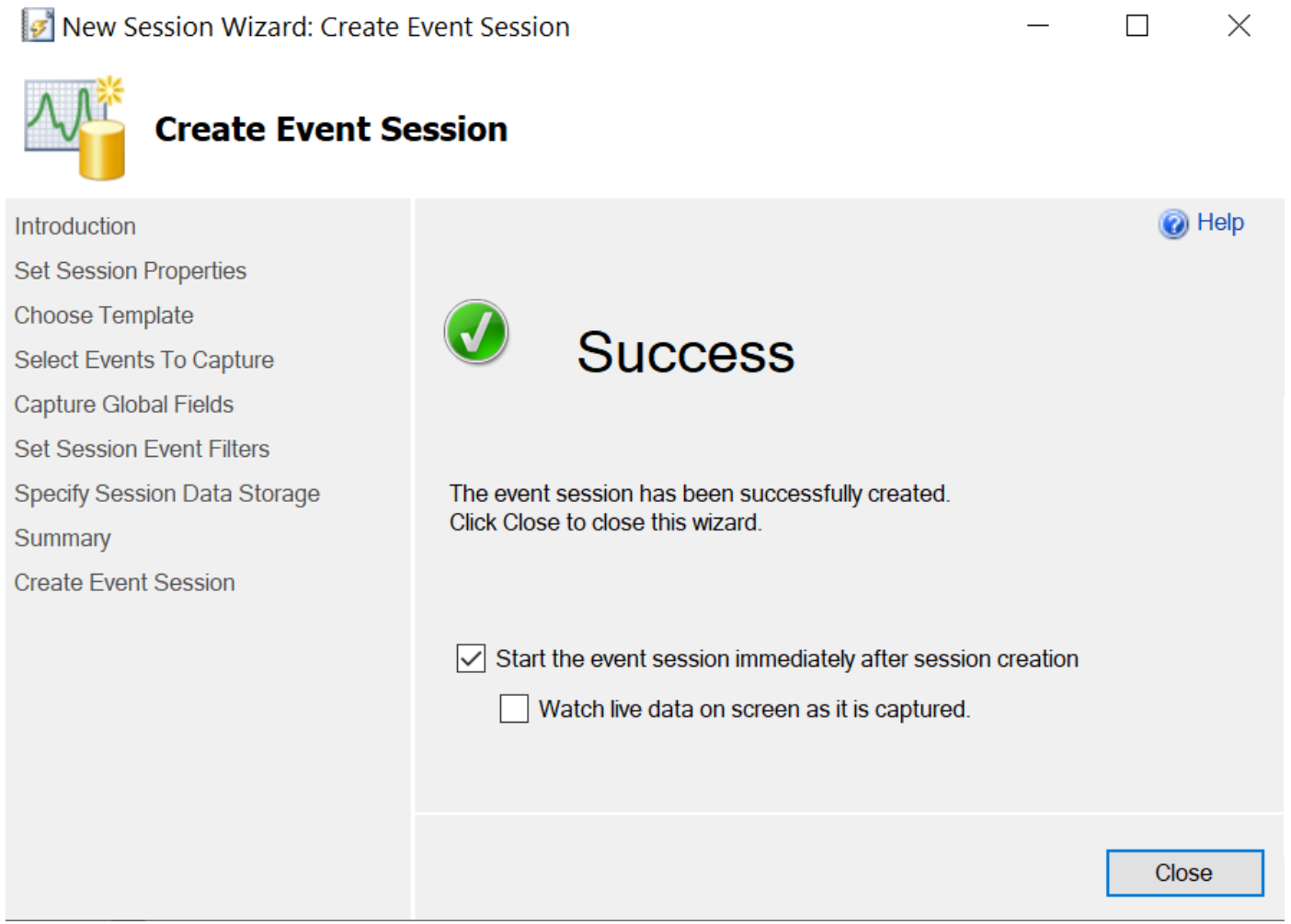
XEVENTS STORING EVENTS



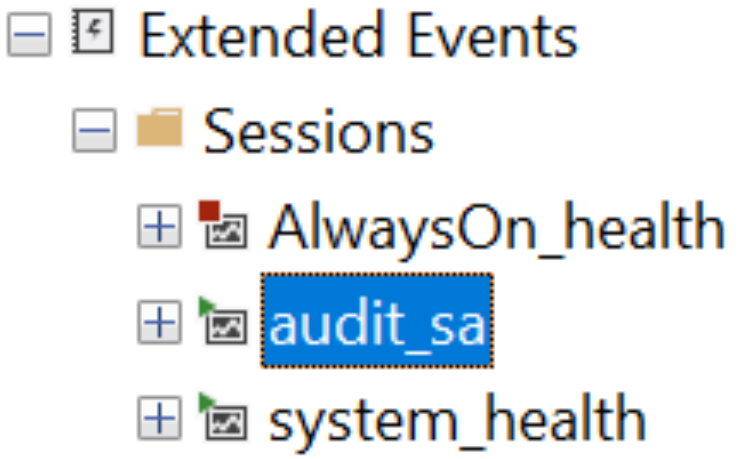
XEVENTS SUMMARY



XEVENTS CREATED



When you refresh extended events in SSMS, you will see your new xevent



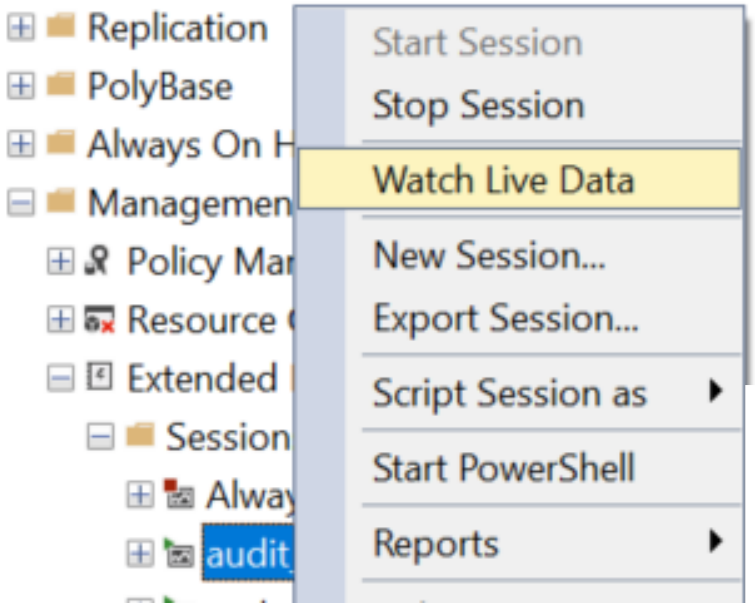
XEVENT FILES ON DISK

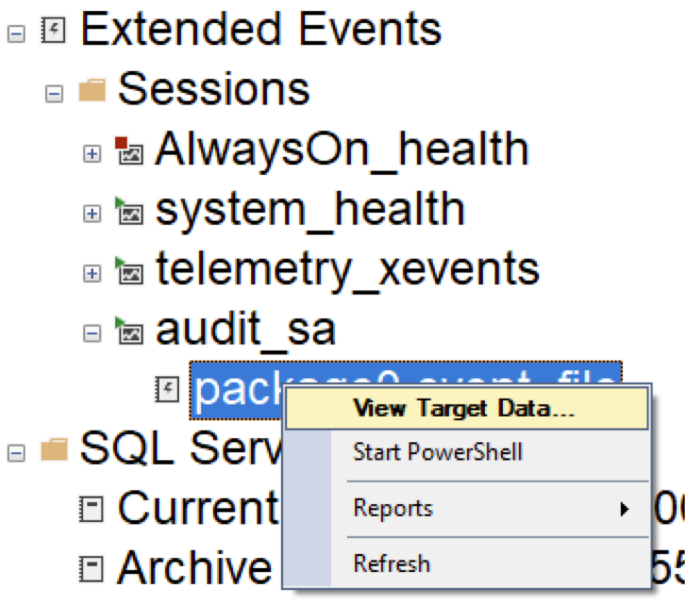
Once the xevent is enabled, it will place a file on disk

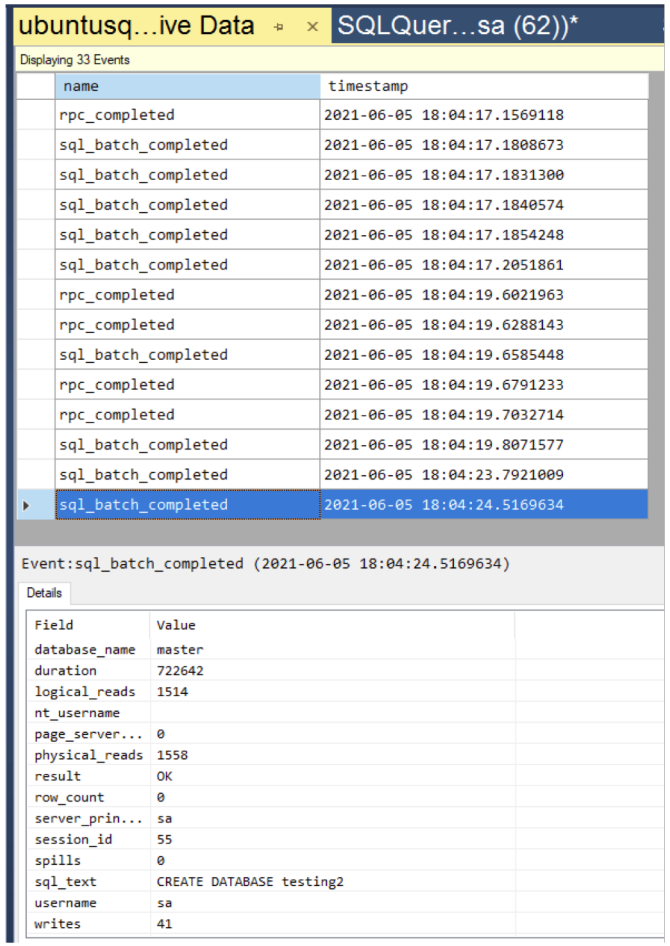
Name	Date modified	Type	Size
audit_sa_0_132578089159200000	2/14/2021 2:08 PM	Microsoft SQL Server Extended Event Log File	100 KB

QUERY EXTENDED EVENTS VIA GUI

View extended event data via SSMS







CREATE EXTENDED EVENT VIA SCRIPT

Configure with script in SSMS

```
CREATE EVENT SESSION [audit_sa] ON SERVER
ADD EVENT sqlserver.rpc_completed(
    ACTION(sqlserver.client_app_name,
                sqlserver.client_hostname,
                sqlserver.database_name,
                sqlserver.server_instance_name,
                sqlserver.server_principal_name,
                sqlserver.sql_text)),
ADD EVENT sqlserver.sql_batch_completed(
ACTION(sqlserver.client_app_name,sqlserver.client_hostname,sqlserver.database_name,sqlser
ver.server_instance_name,sqlserver.server_principal_name,sqlserver.sql_text))
ADD TARGET package0.event_file(SET
filename=N'E:\audits\audit_sa.xel',max_file_size=(10),max_rollover_files=(10))
WITH (STARTUP_STATE=ON)
GO
ALTER EVENT SESSION [audit_sa]
ON SERVER STATE = START;
GO
```

QUERY EXTENDED EVENTS VIA SCRIPT

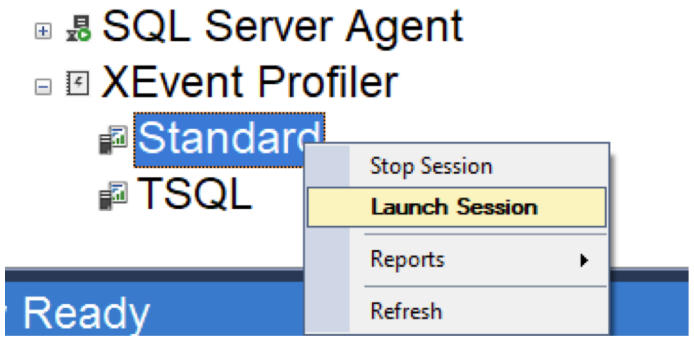
```
SELECT n.value('(@timestamp)[1]', 'datetime') as timestamp,
       n.value('(action[@name="sql_text"]/value)[1]', 'nvarchar(max)') as [sql],
       n.value('(action[@name="client_hostname"]/value)[1]', 'nvarchar(50)') as [client_hostname],
       n.value('(action[@name="server_principal_name"]/value)[1]', 'nvarchar(50)') as [user],
       n.value('(action[@name="database_name"]/value)[1]', 'nvarchar(50)') as [database_name],
       n.value('(action[@name="client_app_name"]/value)[1]', 'nvarchar(50)') as [client_app_name]
FROM (select cast(event_data as XML) as event_data
FROM sys.fn_xe_file_target_read_file('e:\audits\*.xel', NULL, NULL, NULL)) ed
CROSS APPLY ed.event_data.nodes('event') as q(n)
WHERE n.value('(@timestamp)[1]', 'datetime') >= DATEADD(HOUR, -1, GETDATE())
ORDER BY timestamp desc
```

200 %

Results | Messages

	timestamp	sql	client_hostname	user	database_name	client_app_name
113	2021-06-06 00:15:28.117	(@source nvarchar(256),@sourceopt int)SELECT type, data ...	DESKTOP-15BFKLR	sa	NULL	NULL
114	2021-06-06 00:15:50.757	select @@trancount	DESKTOP-15BFKLR	sa	NULL	NULL
115	2021-06-06 00:15:54.893	SELECT @@SPID;	DESKTOP-15BFKLR	sa	NULL	NULL
116	2021-06-06 00:15:55.550	CREATE DATABASE testing2	DESKTOP-15BFKLR	sa	NULL	NULL
117	2021-06-06 00:16:00.827	SELECT @@SPID;	DESKTOP-15BFKLR	sa	NULL	NULL
118	2021-06-06 00:16:02.207	select n.value('(@timestamp)[1]', 'datetime') as timestamp, n....	DESKTOP-15BFKLR	sa	NULL	NULL
119	2021-06-06 00:16:12.943	(@_msparam_0 nvarchar(4000))SELECT dtb.collation_name...	DESKTOP-15BFKLR	sa	NULL	NULL
120	2021-06-06 00:16:12.960	SELECT dtb.name AS [Name], dtb.database_id AS [ID], CAS...	DESKTOP-15BFKLR	sa	NULL	NULL
121	2021-06-06 00:16:15.107	SELECT @@SPID;	DESKTOP-15BFKLR	sa	NULL	NULL
122	2021-06-06 00:16:16.547	select n.value('(@timestamp)[1]', 'datetime') as timestamp, n....	DESKTOP-15BFKLR	sa	NULL	NULL
123	2021-06-06 00:16:30.827	SELECT @@SPID;	DESKTOP-15BFKLR	sa	NULL	NULL
124	2021-06-06 00:16:32.290	select n.value('(@timestamp)[1]', 'datetime') as timestamp, n....	DESKTOP-15BFKLR	sa	NULL	NULL
125	2021-06-06 00:17:35.177	SELECT @@SPID;	DESKTOP-15BFKLR	sa	NULL	NULL
126	2021-06-06 00:17:35.180	select n.value('(@timestamp)[1]', 'datetime') as timestamp, n....	DESKTOP-15BFKLR	sa	NULL	NULL

QUICK VIEW XEVENTS VIA GUI



Make sure to stop it when you are done

ubuntusq...ive Data | SQLQuer...sa (70))* | SQLQuer...sa (62))* | SQLQuer...ng (68))*

Displaying 25 Events

ev...	name	[TextData]	client_app_name	nt_user...	cpu_...	logical...	wr...	dura...	sessi...	times
48	sql_batch_starting	SET DEADLOCK_PRIORITY -10	SQLServerCEIP	NT AUTHO...	NULL	NULL	NULL	NULL	57	2021-
49	sql_batch_compl...	SET DEADLOCK_PRIORITY -10	SQLServerCEIP	NT AUTHO...	0	0	0	71	57	2021-
50	sql_batch_starting	SELECT target_data FROM...	SQLServerCEIP	NT AUTHO...	NULL	NULL	NULL	NULL	57	2021-
51	sql_batch_compl...	SELECT target_data FROM...	SQLServerCEIP	NT AUTHO...	56000	0	0	75024	57	2021-
52	logout	NULL	SQLServerCEIP	NT AUTHO...	56000	0	0	107000	57	2021-
53	rpc_completed	exec sp_reset_connection	SQLServerCEIP	NT AUTHO...	0	0	0	23	57	2021-
54	login	-- network protocol: TCP/IP set ...	SQLServerCEIP	NT AUTHO...	NULL	NULL	NULL	NULL	57	2021-
55	sql_batch_starting	SET DEADLOCK_PRIORITY -10	SQLServerCEIP	NT AUTHO...	NULL	NULL	NULL	NULL	57	2021-
56	sql_batch_compl...	SET DEADLOCK_PRIORITY -10	SQLServerCEIP	NT AUTHO...	0	0	0	63	57	2021-
57	sql_batch_starting	if not exists (select * from sys....	SQLServerCEIP	NT AUTHO...	NULL	NULL	NULL	NULL	57	2021-
58	sql_batch_compl...	if not exists (select * from sys....	SQLServerCEIP	NT AUTHO...	1000	20	0	1021	57	2021-
59	sql_batch_starting	select @@trancount	Microsoft SQL Se...		NULL	NULL	NULL	NULL	55	2021-
60	sql_batch_compl...	select @@trancount	Microsoft SQL Se...		0	0	0	438	55	2021-
61	logout	NULL	Microsoft SQL Se...		3166000	23315	480	9856...	55	2021-

Event:sql_batch_starting (2021-06-05 20:42:13.9988789)

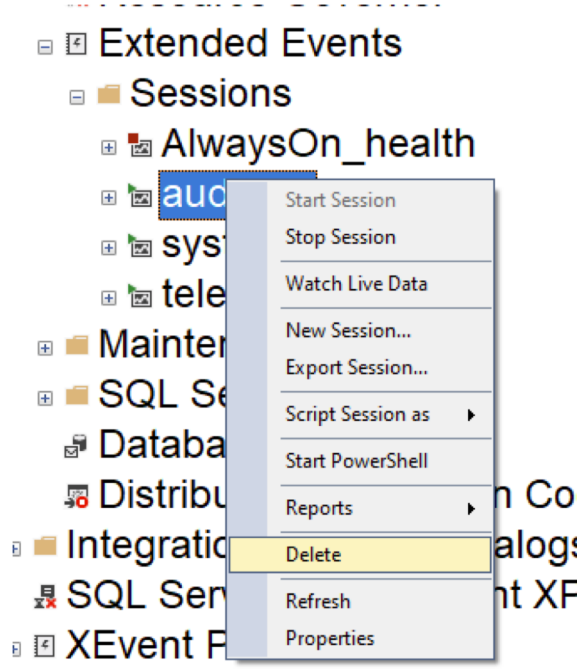
Details

Field	Value
attach_acti...	0861B6DE-687C-4C2F-8349-23730C1EE224
attach_acti...	1
attach_acti...	F608C412-96E9-4252-809D-C8EA63E17003
attach_acti...	0
batch_text	SET DEADLOCK_PRIORITY -10
client_app_...	SQLServerCEIP
client_pid	32
database_id	1
database_name	master
event_sequence	48
nt_username	NT AUTHORITY\SYSTEM
query_hash	0
server_prin...	NT AUTHORITY\SYSTEM
session_id	57

DELETING XEVENTS

Two ways to delete xevents

GUI



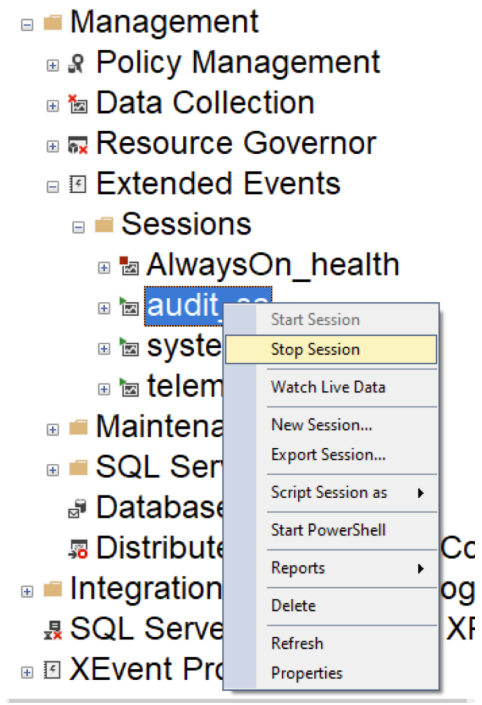
Script

```
DROP EVENT SESSION [audit_sa]
ON SERVER
GO
```

STOPPING XEVENTS

Two ways to stop xevents

GUI



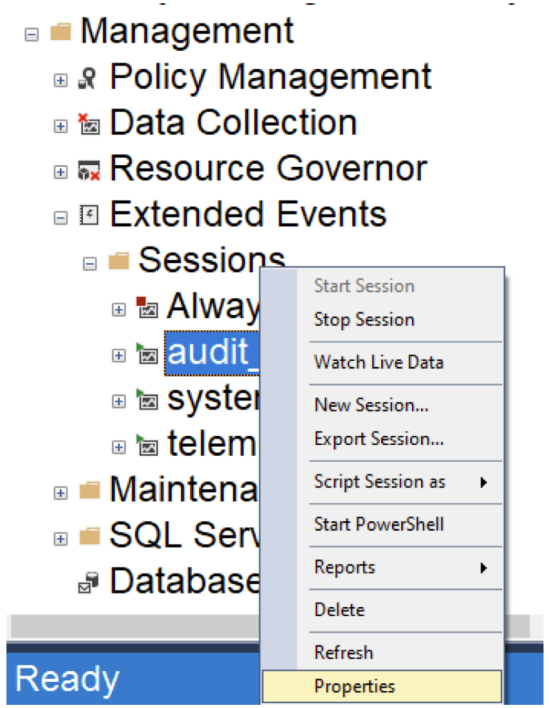
Script

```
ALTER EVENT SESSION [audit_sa]
ON SERVER STATE = STOP;
GO
```

MODIFYING XEVENTS

Two ways to change xevents

GUI



Script

```
ALTER EVENT SESSION [audit_sa] ON
SERVER
DROP EVENT sqlserver.rpc_completed
ALTER EVENT SESSION [audit_sa] ON
SERVER
ADD EVENT sqlserver.rpc_completed(
    ACTION(sqlserver.client_app_name,sqlserver.cl
ient_hostname,sqlserver.database_name,sqlserve
r.server_instance_name,sqlserver.server_principal
_name,sqlserver.sql_text,sqlserver.username))
```

EXTENDED EVENTS REVIEW

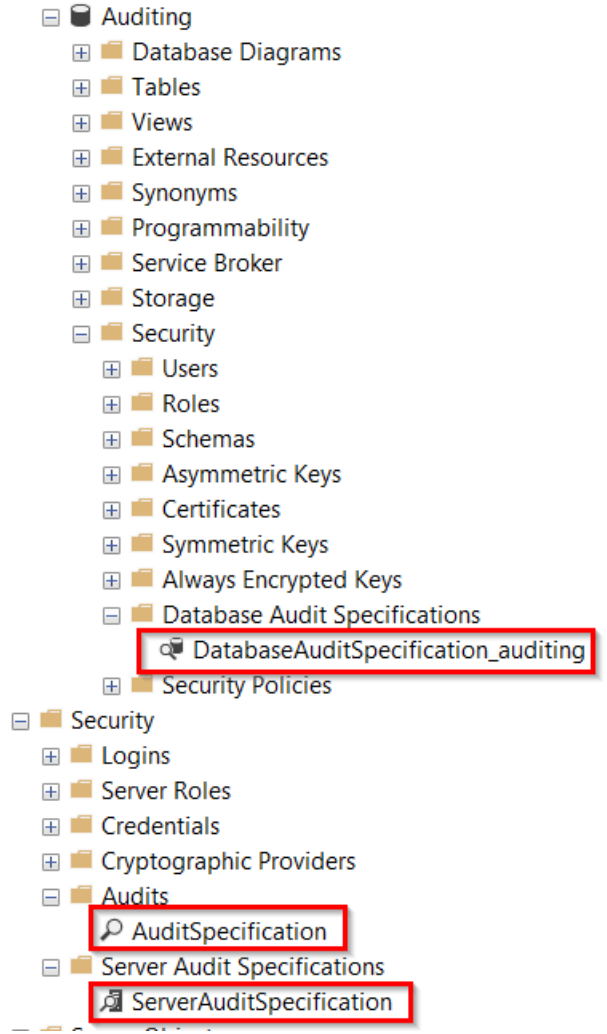
Lightweight, customizable

Best for capturing what a user is doing and/or what's changing on an entire database or server

Create via GUI or scripts

EXTENDED EVENTS DEMO

SQL SERVER AUDIT



Lightweight and flexible

Good for auditing user actions

Uses extended events under the hood

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

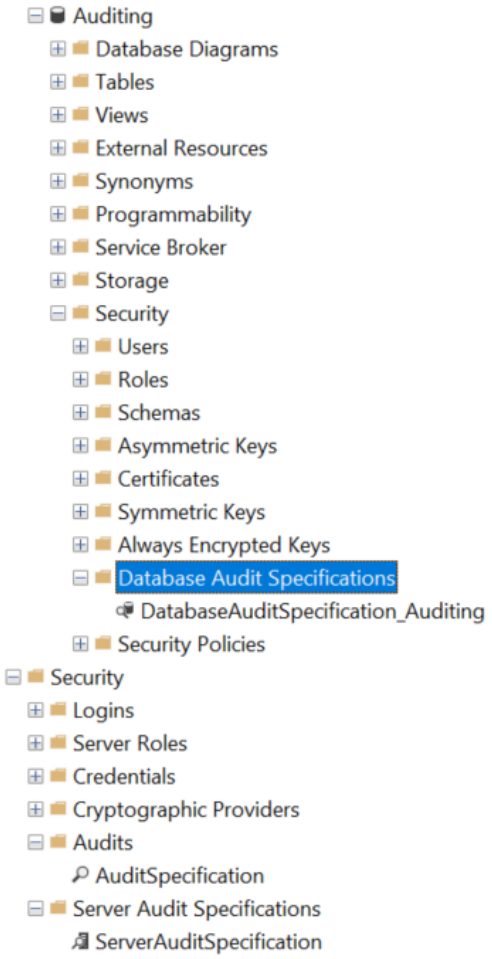
SQL SERVER AUDIT REQUIREMENTS

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

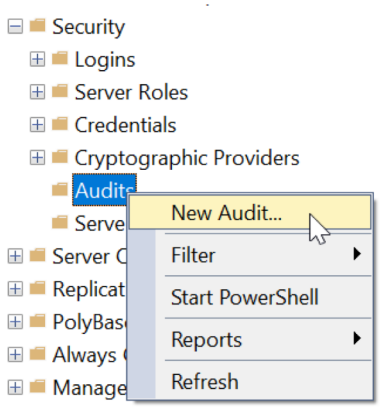


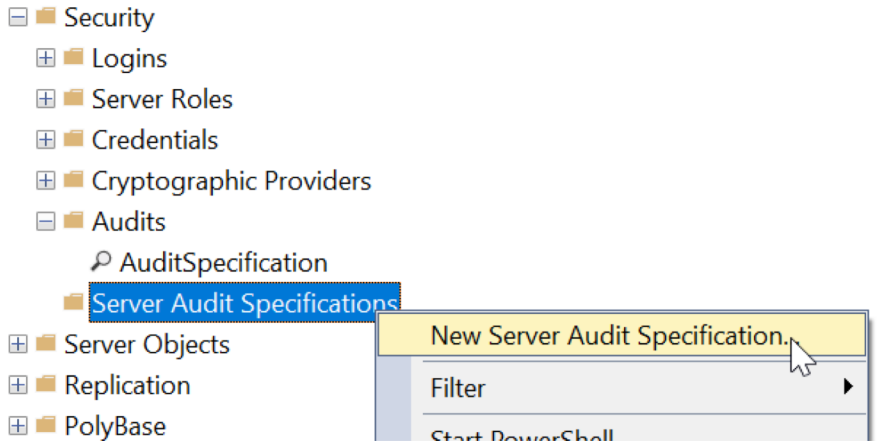
SQL SERVER AUDIT USE CASES

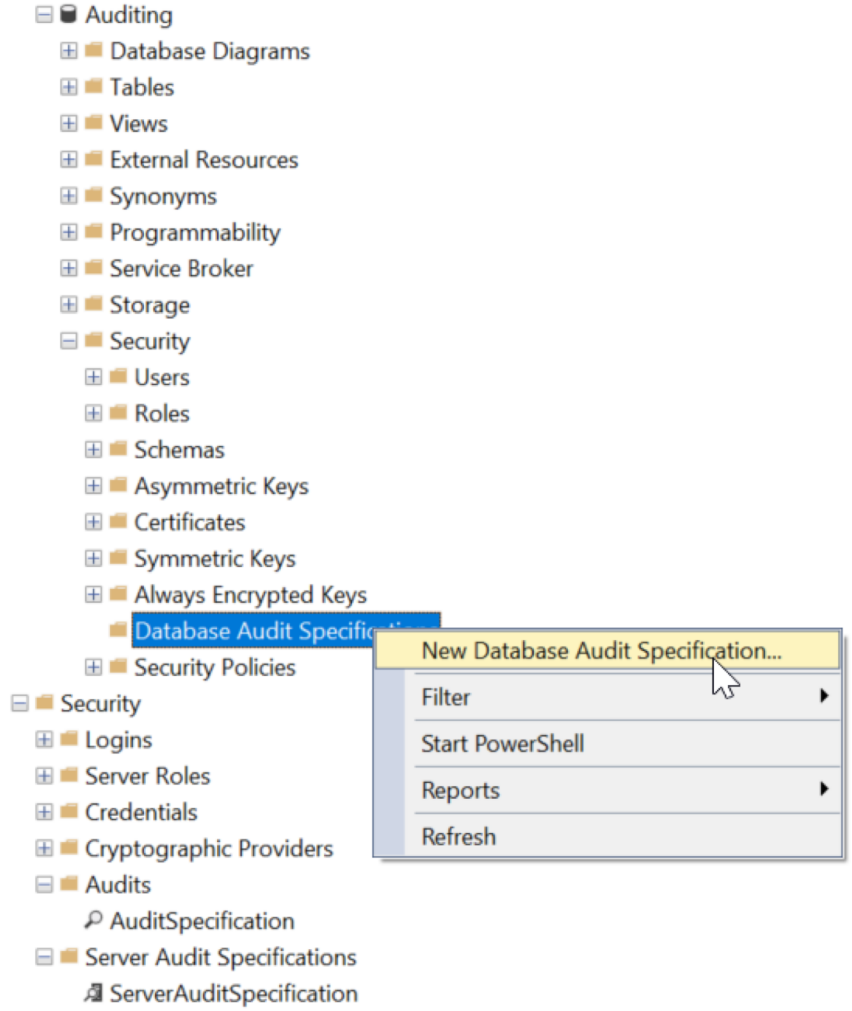
A server audit specification is good for auditing server level and/or all databases at the same time

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

CREATE AUDIT VIA GUI

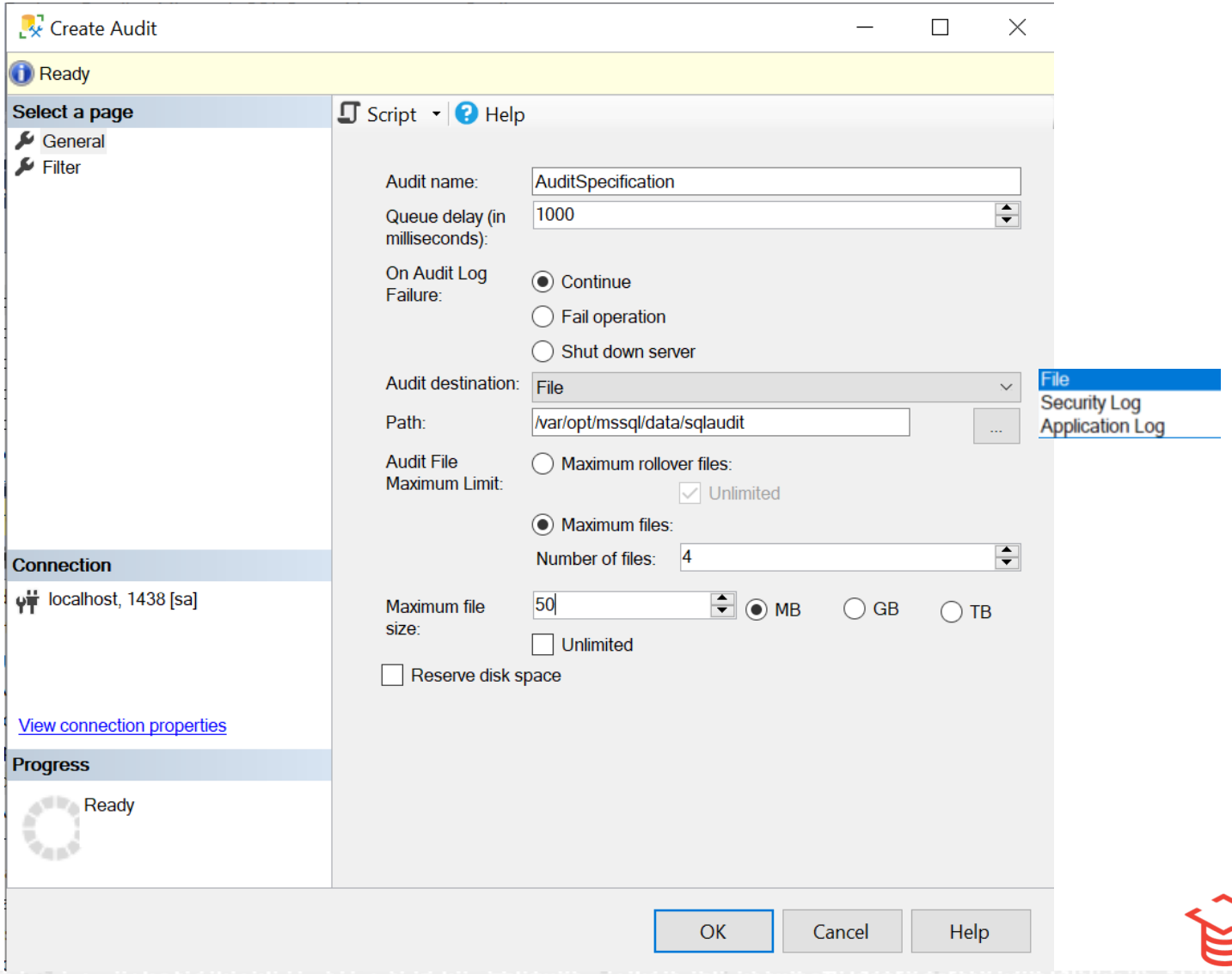






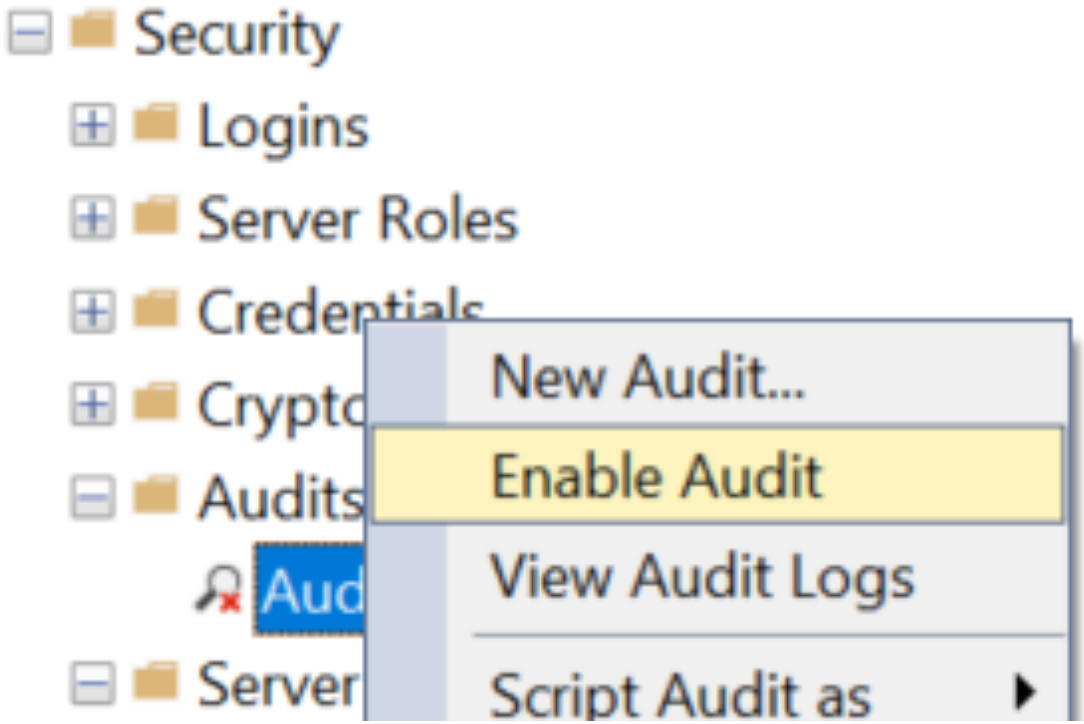
CONFIGURE AUDIT VIA GUI

Configuring an audit specification



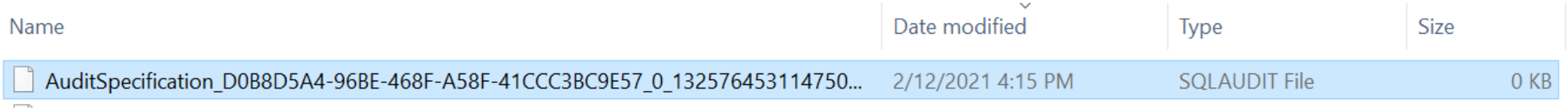
ENABLING AUDIT VIA GUI

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

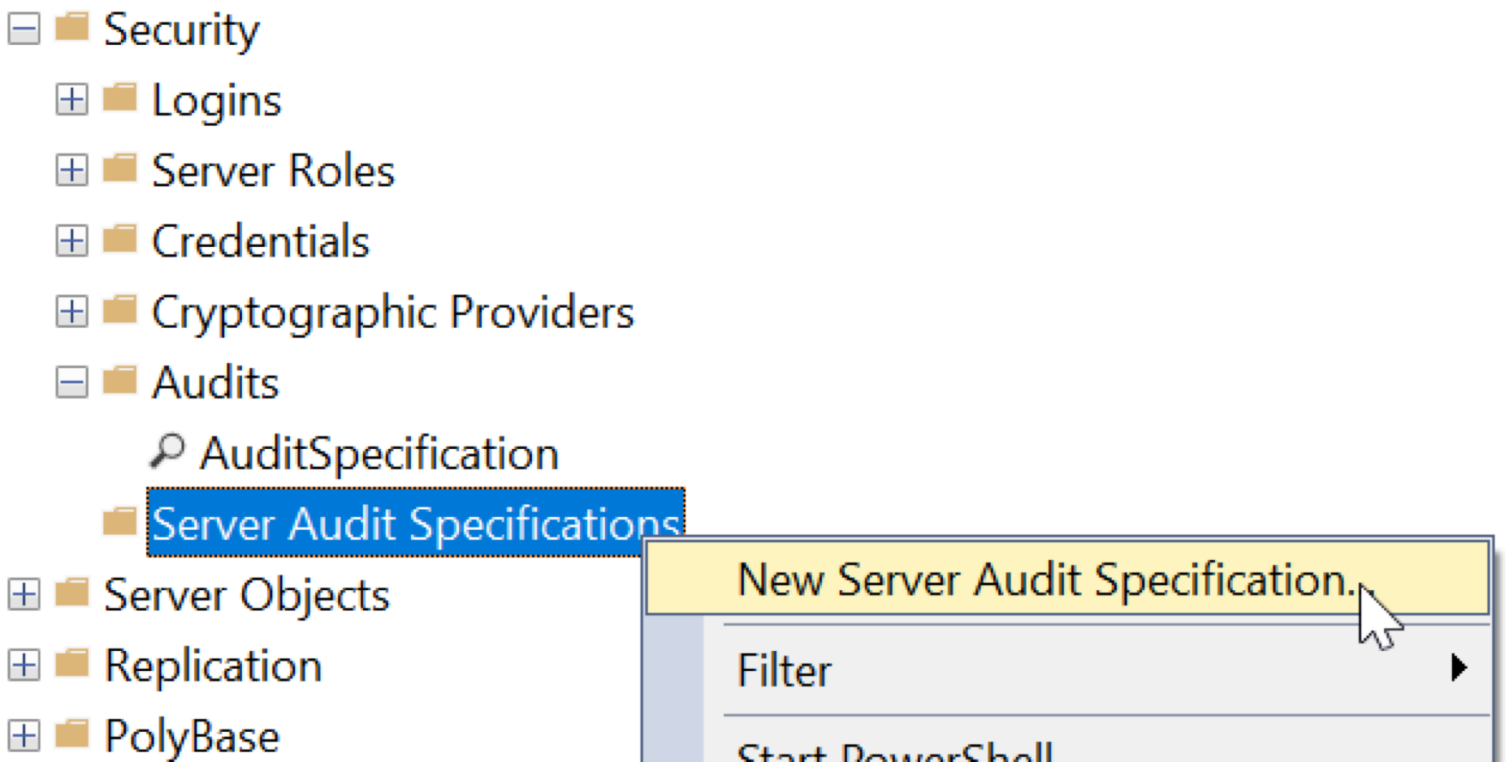
DATABASE AUDIT ACTIONS

Capturing DML

SELECT	Captures SELECT statements
INSERT	Captures INSERT statements
UPDATE	Captures UPDATE statements
DELETE	Captures DELETE statements
EXECUTE	Captures EXECUTE statements

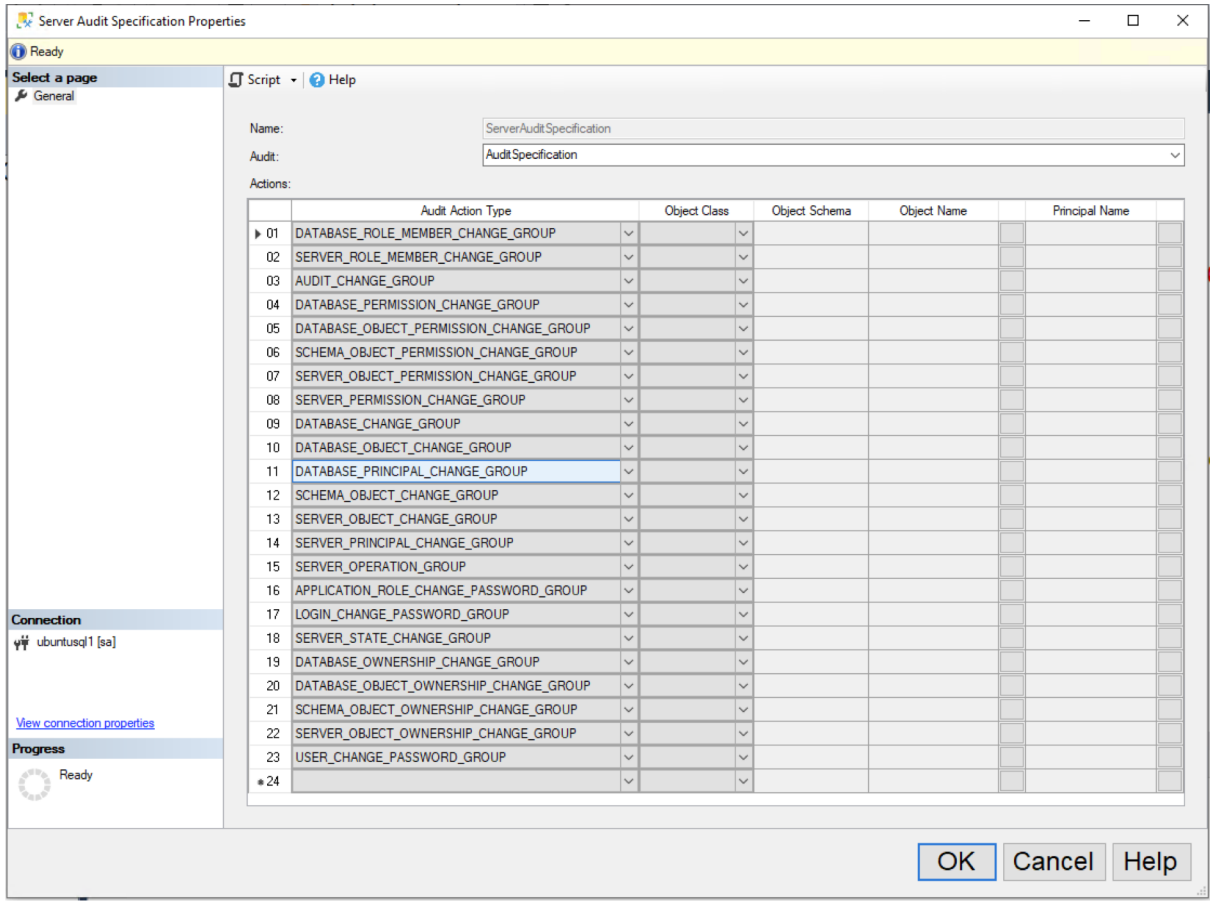
CREATE SERVER AUDIT VIA GUI

Creating a server audit specification in SSMS



CONFIGURE SERVER AUDIT VIA GUI

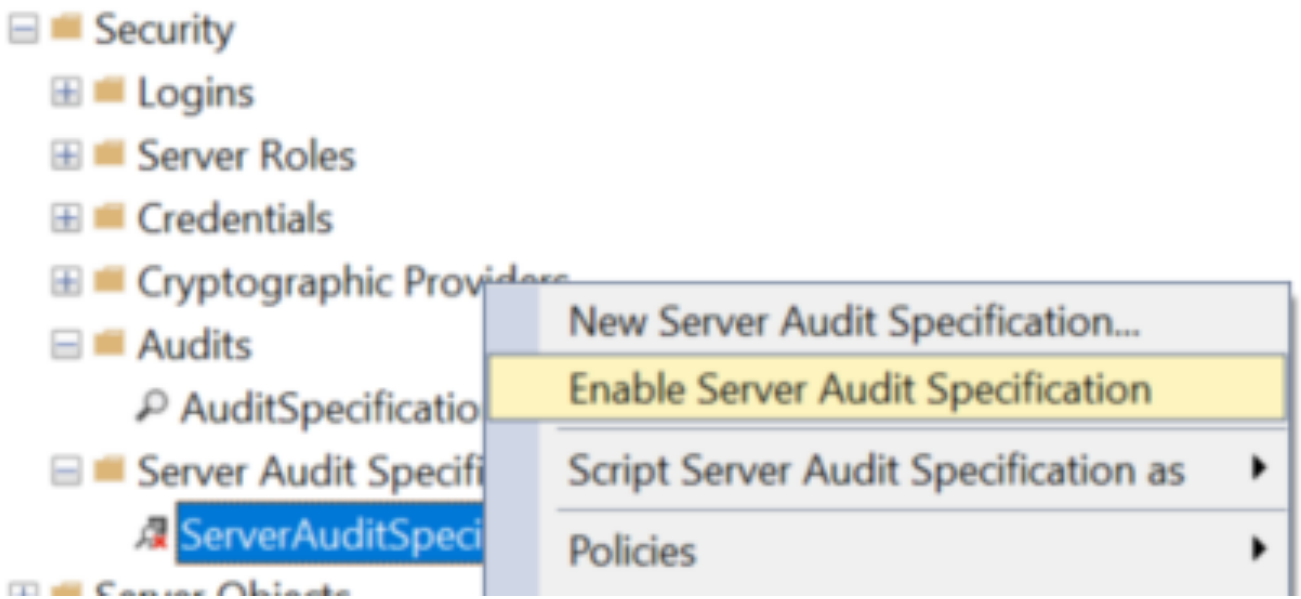
Configuring a server audit specification via SSMS



	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	

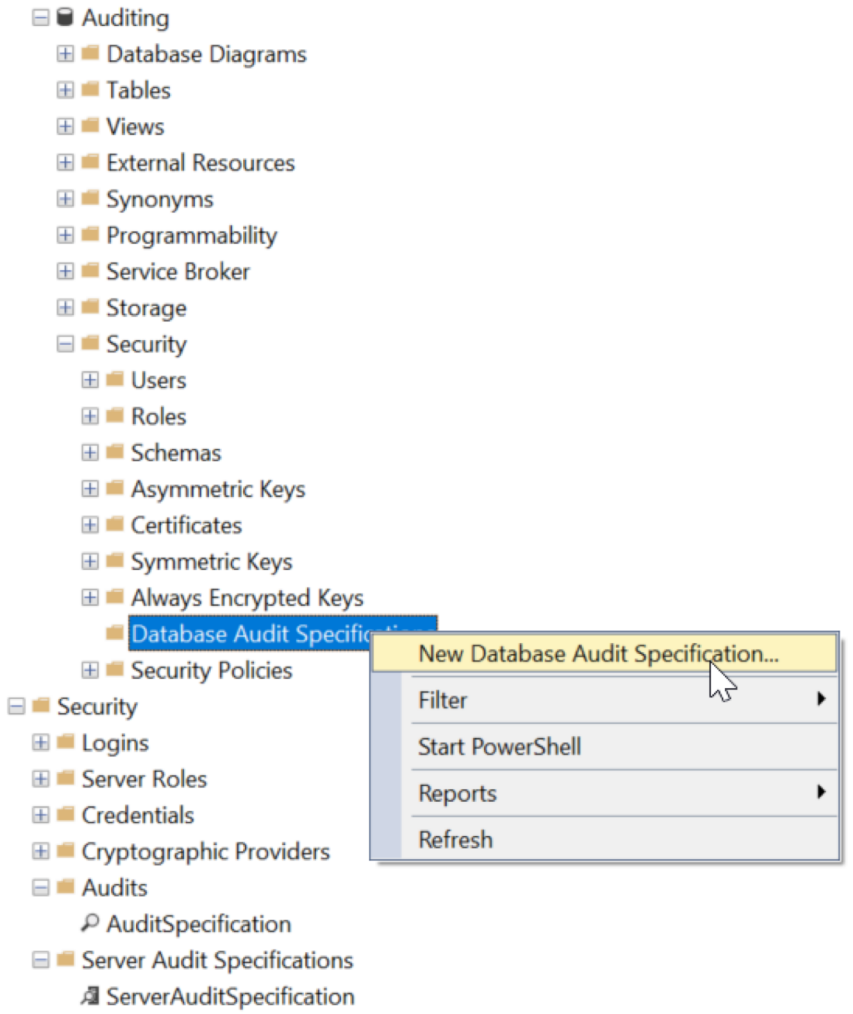
ENABLING SERVER AUDIT VIA GUI

Server audit specifications are disabled after creation by default



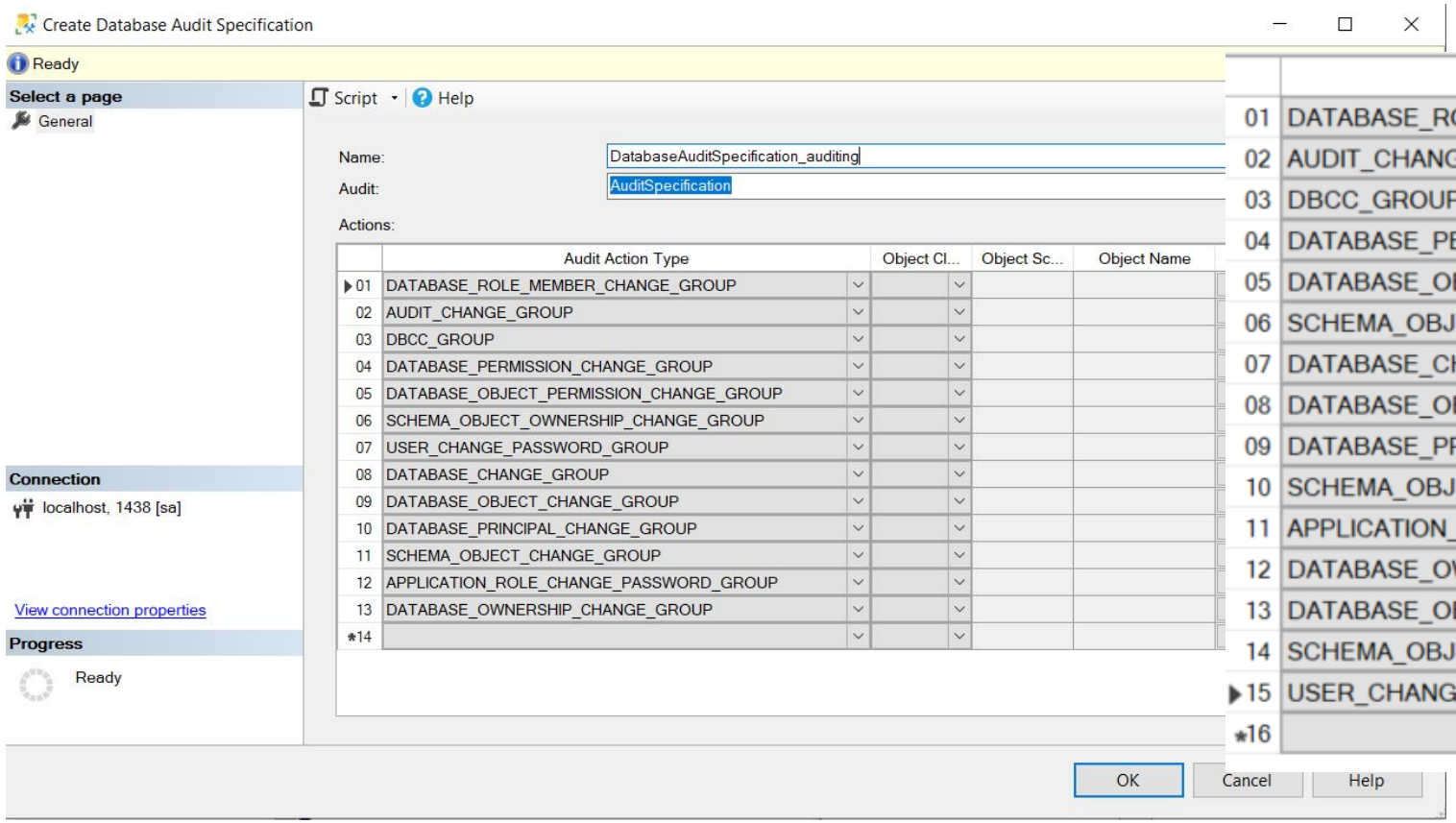
CREATE DATABASE AUDIT VIA GUI

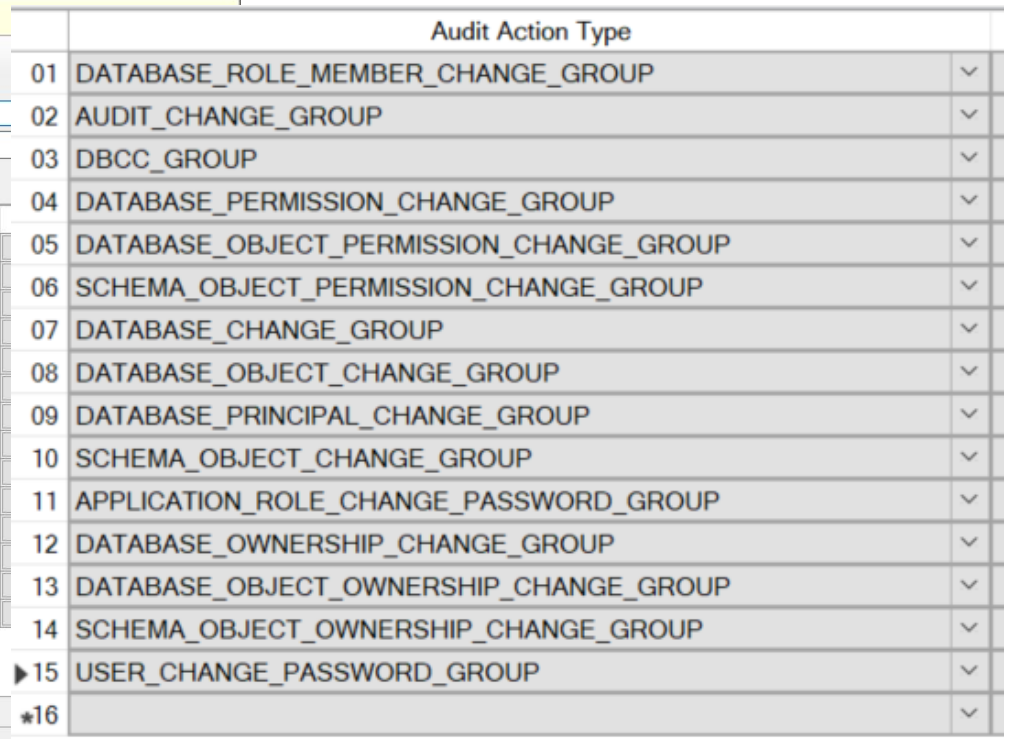
Creating a database audit specification via SSMS



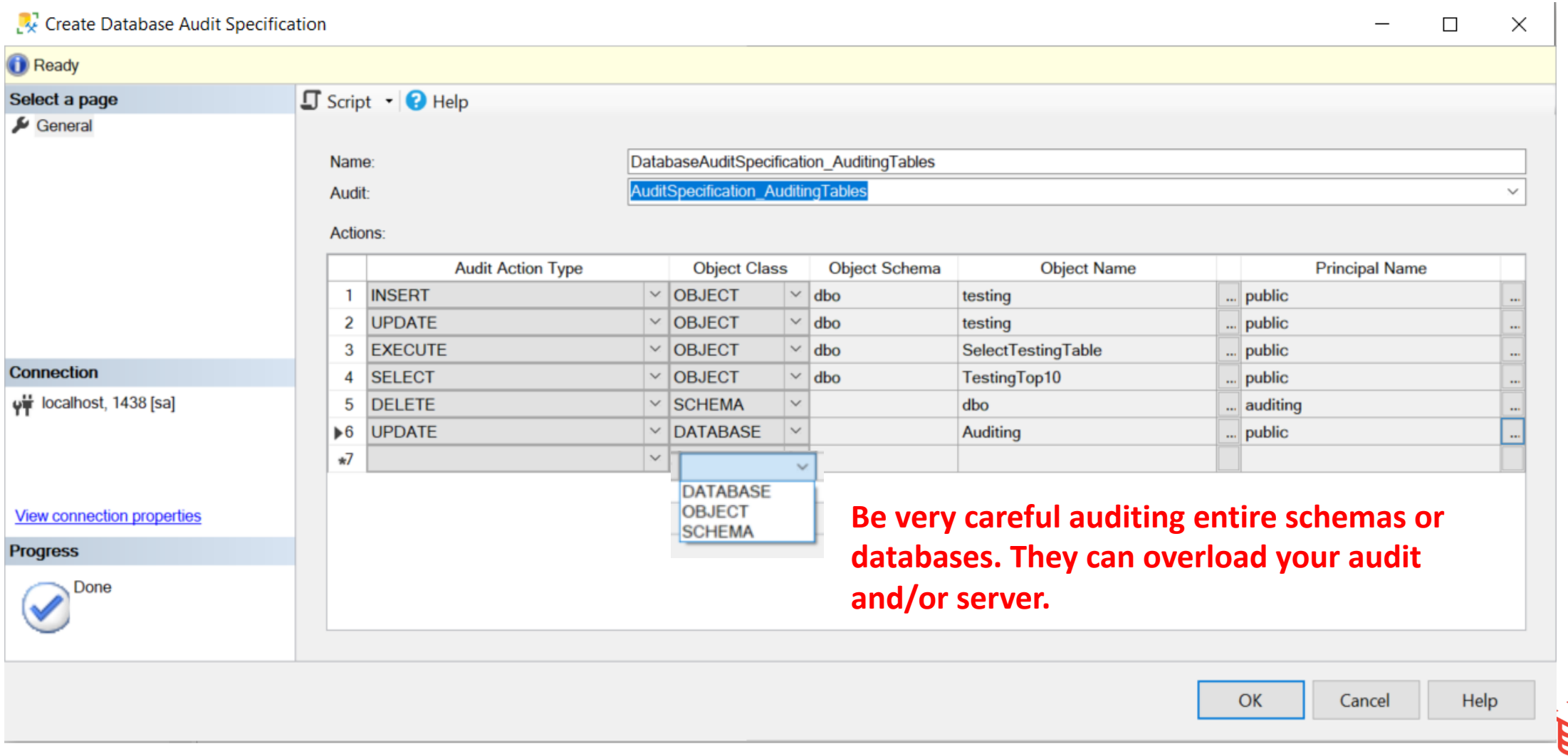
CONFIGURE DATABASE AUDIT VIA GUI

Configuring a database audit specification via SSMS



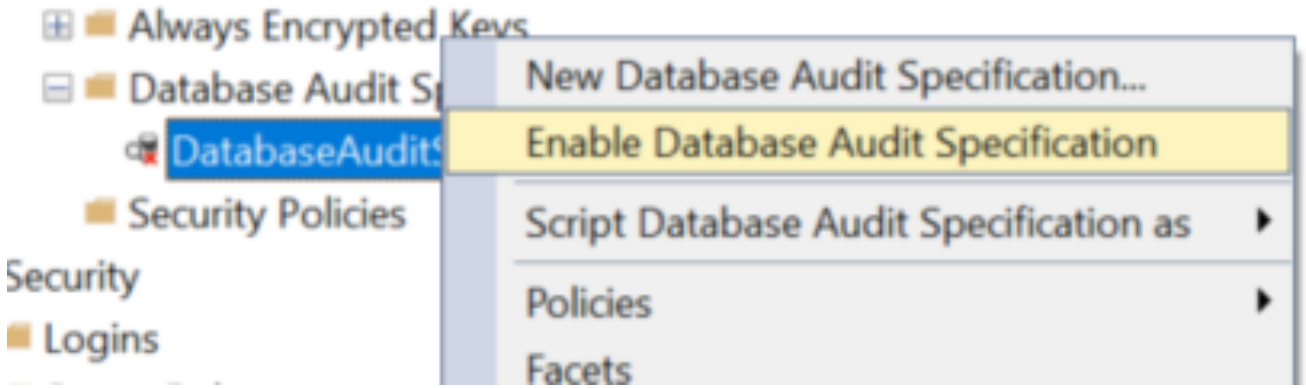


SQL SERVER AUDIT OBJECTS VIA GUI



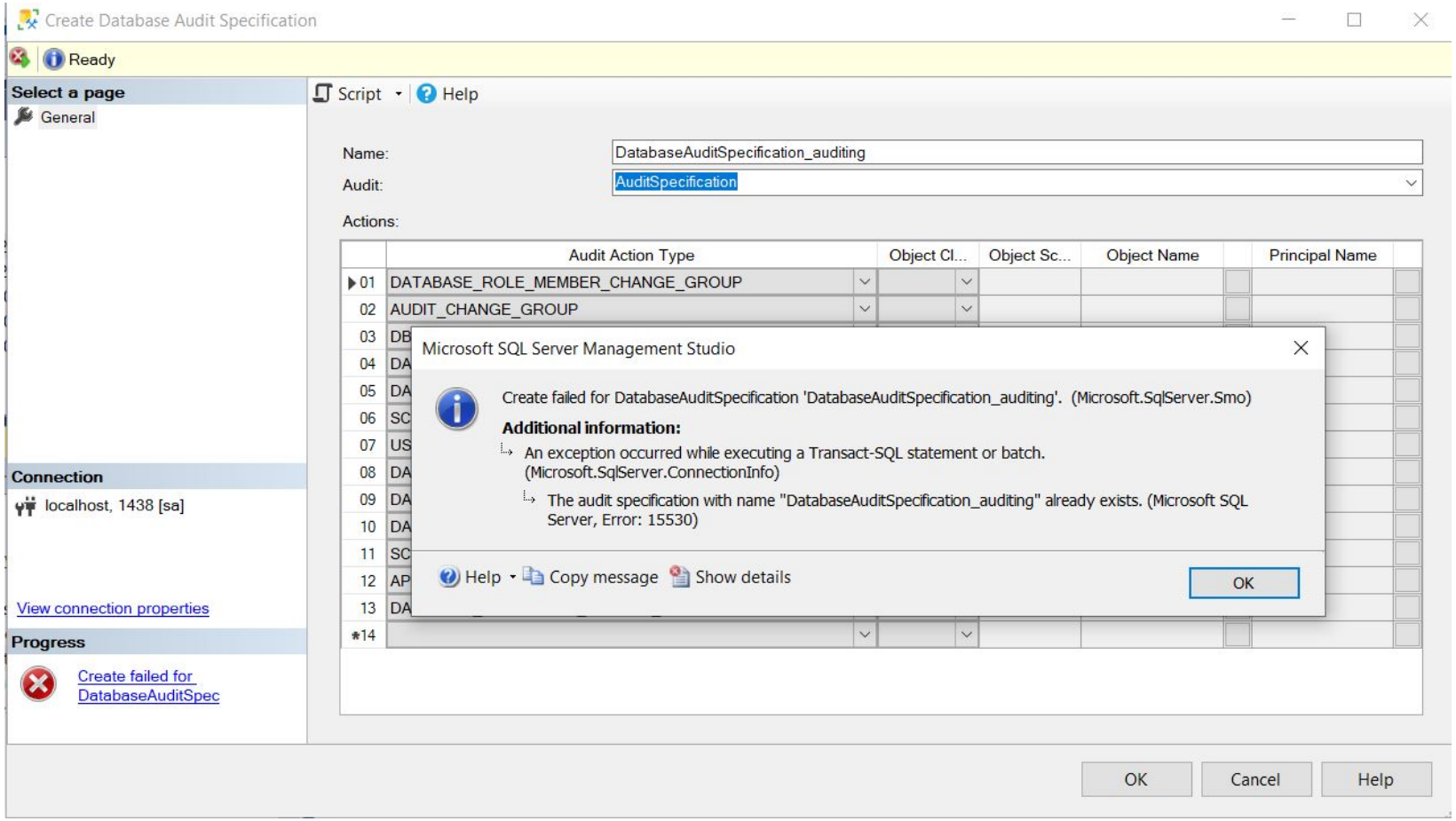
ENABLING DATABASE AUDIT VIA GUI

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



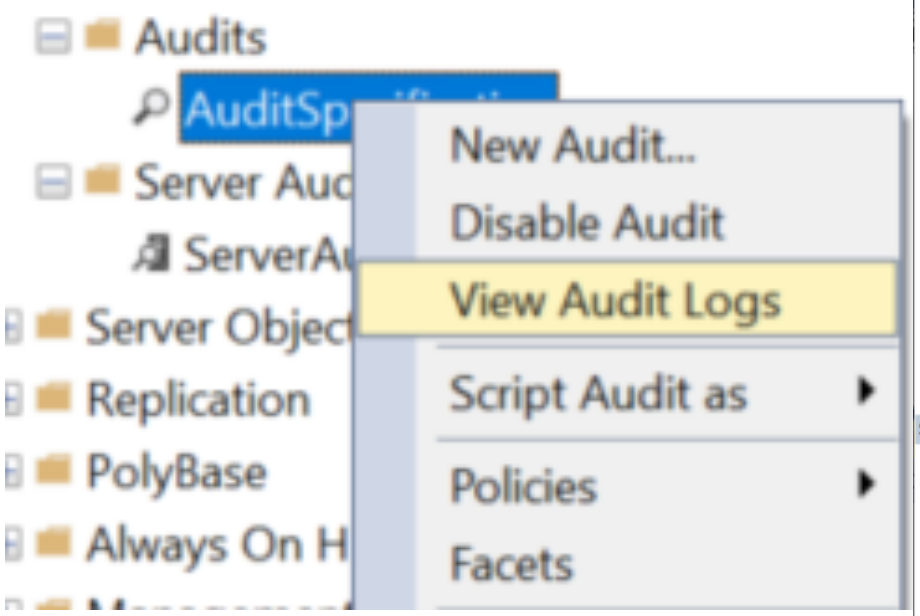
ADDING MULTIPLE AUDITS

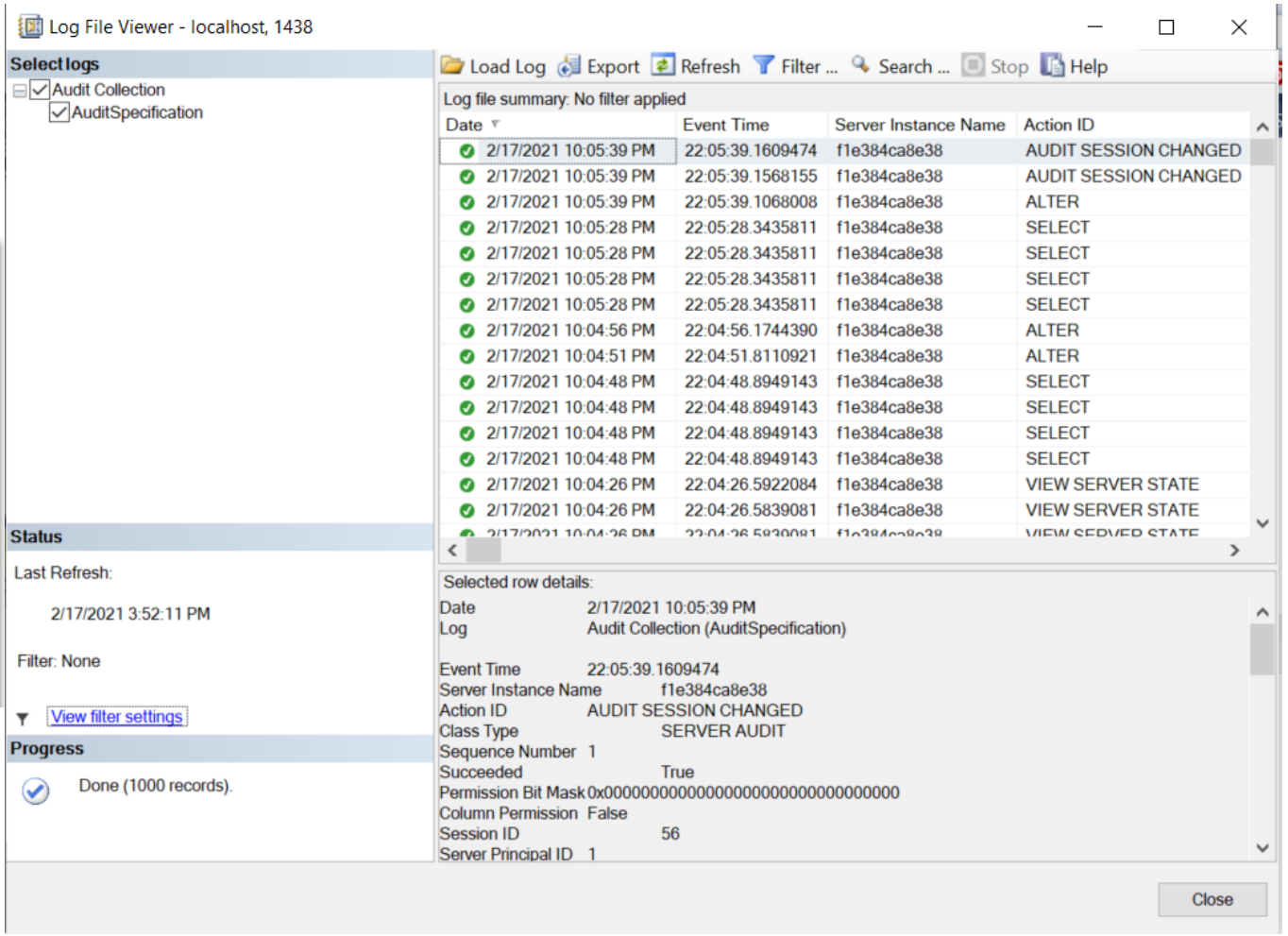
Audit scenario	Audit specification	Server audit specification	Database audit specification
Auditing schema and perms changes at server and db level	Audit_SchemaPerms	ServerAudit_SchemaPerms	
Audit everything sa does	Audit_sa with filter to just get sa user	ServerAudit_sa which includes auditing schema & 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 Don't audit databases at server level	DatabaseAudit_Changes Just on the database you need to audit

QUERYING AUDIT VIA GUI



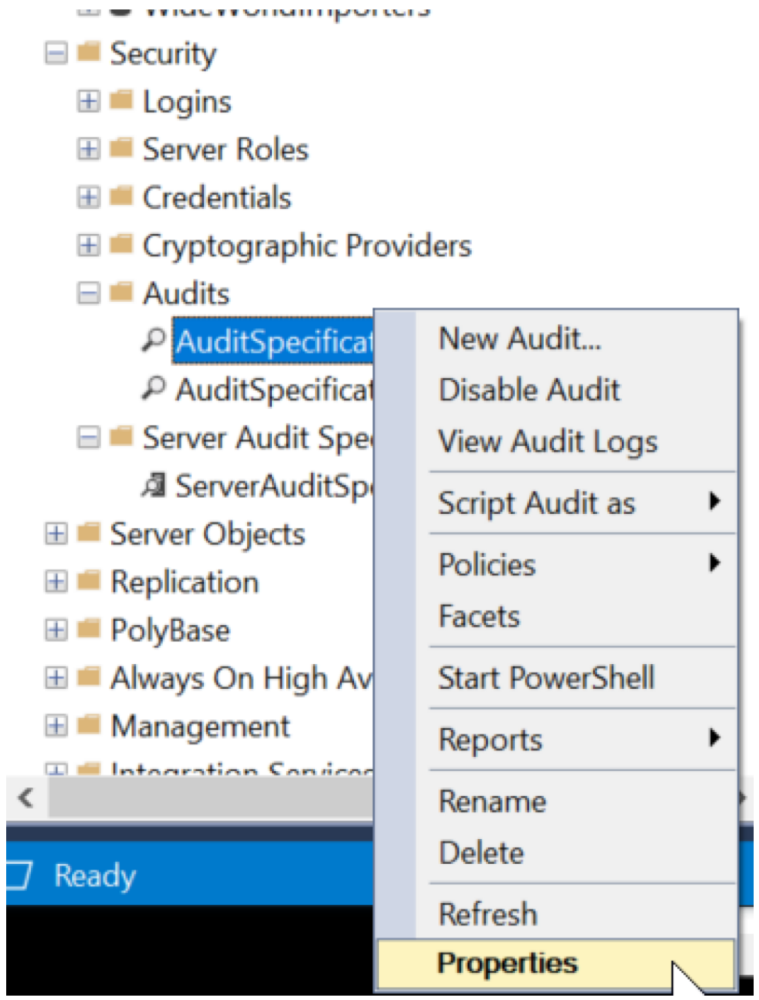


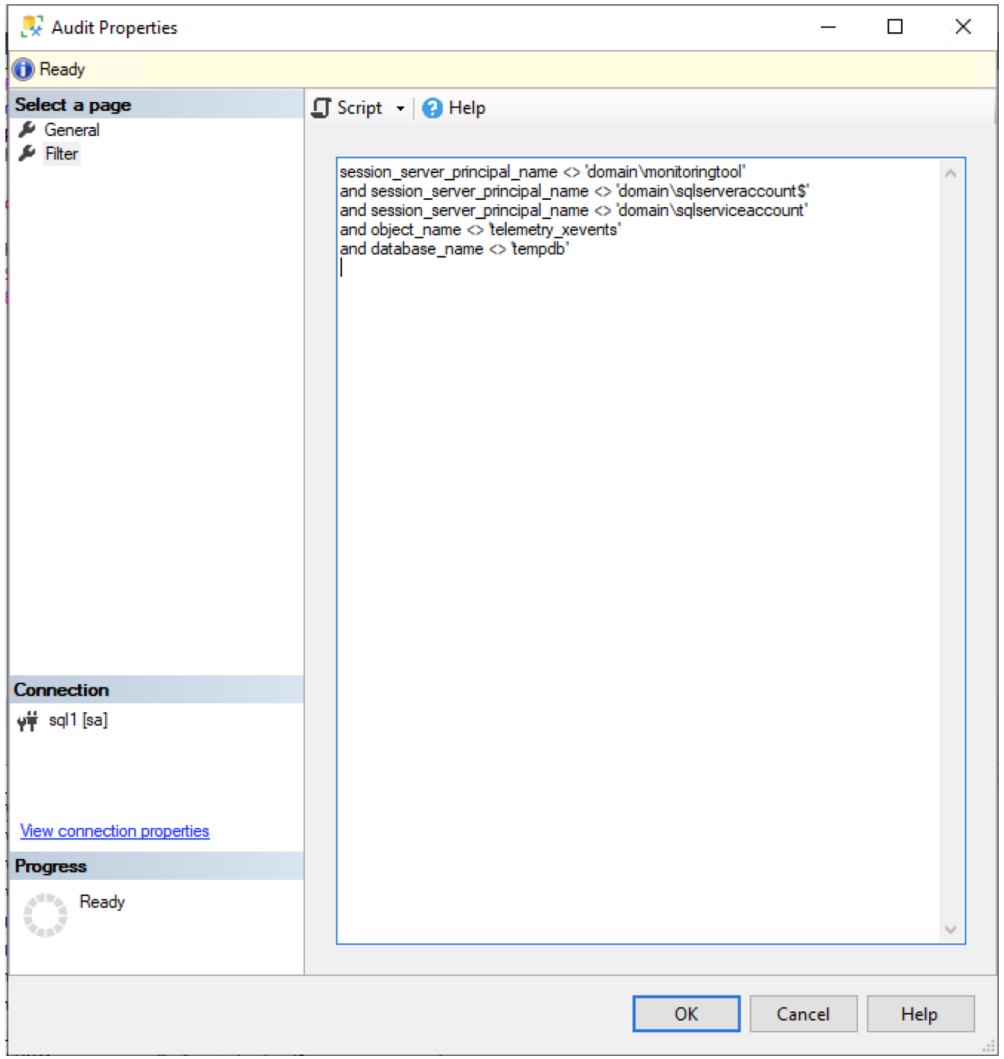
COLUMNS AVAILABLE IN SQL AUDIT

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

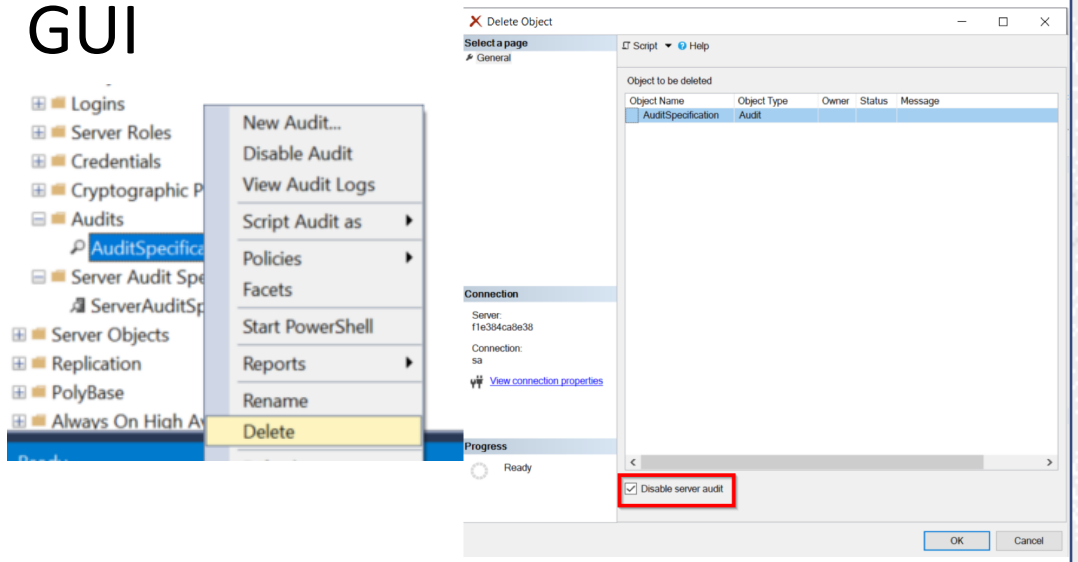




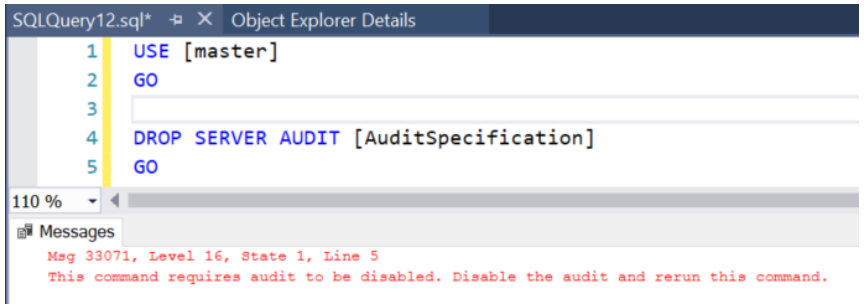
DELETING AUDITS

Two ways to delete audits

GUI



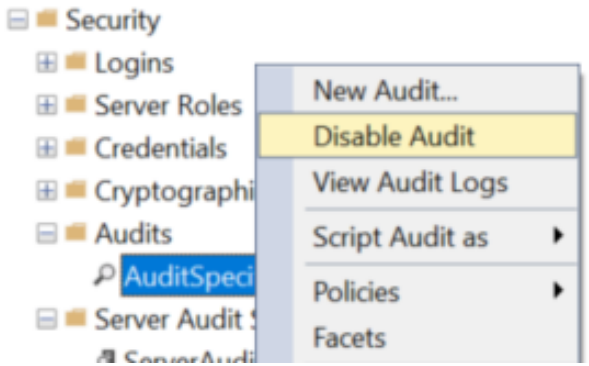
Script



STOPPING AUDITS

Two ways to stop audits

GUI



Script

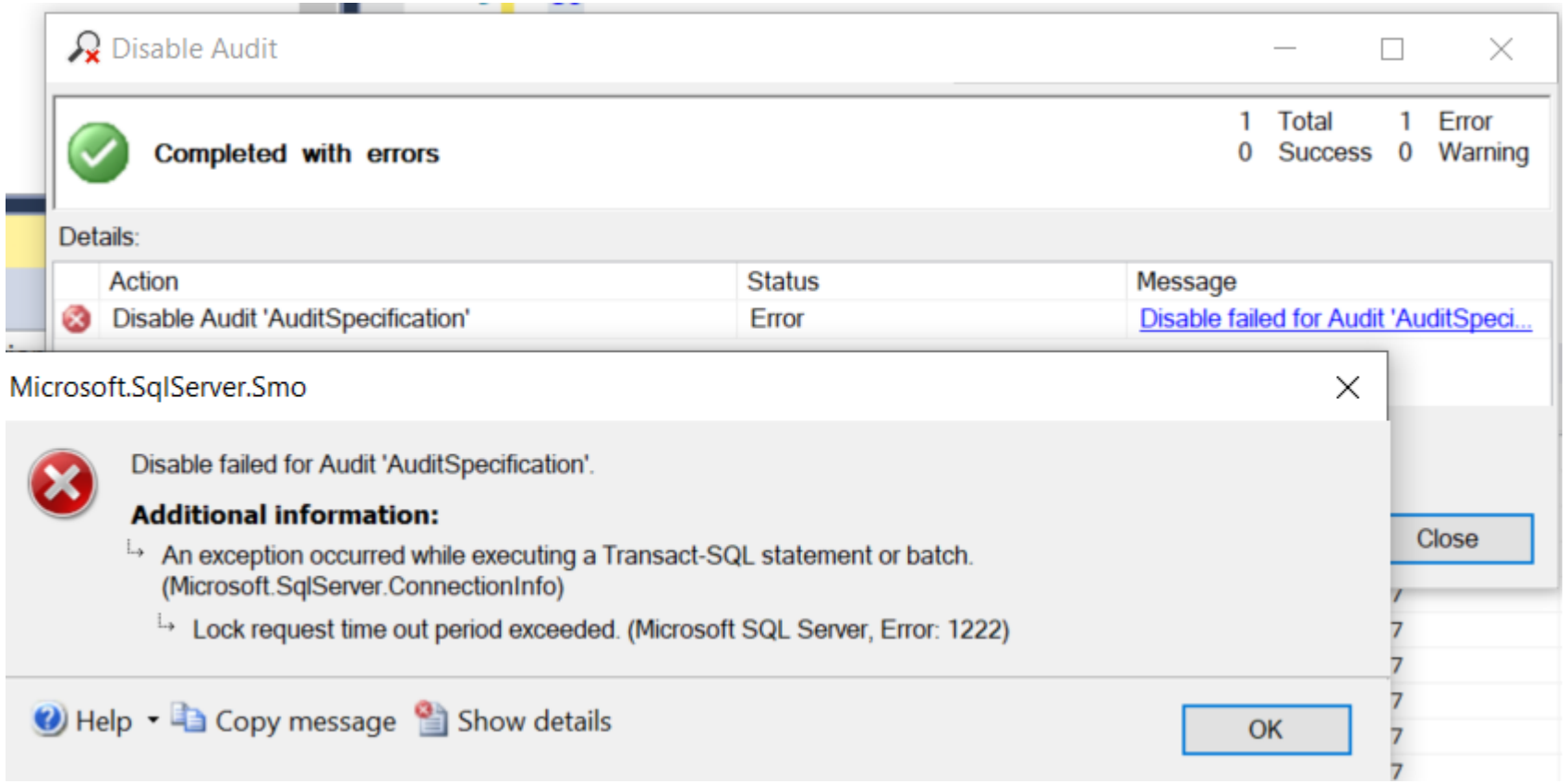
```
USE master;
ALTER SERVER AUDIT AuditSpecification
WITH (STATE = OFF);
```

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

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

STOPPING AUDIT FAILURE

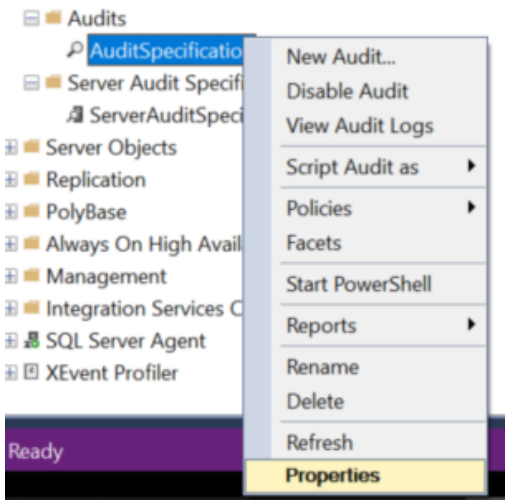
If you have long running queries preventing stopping audit



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:

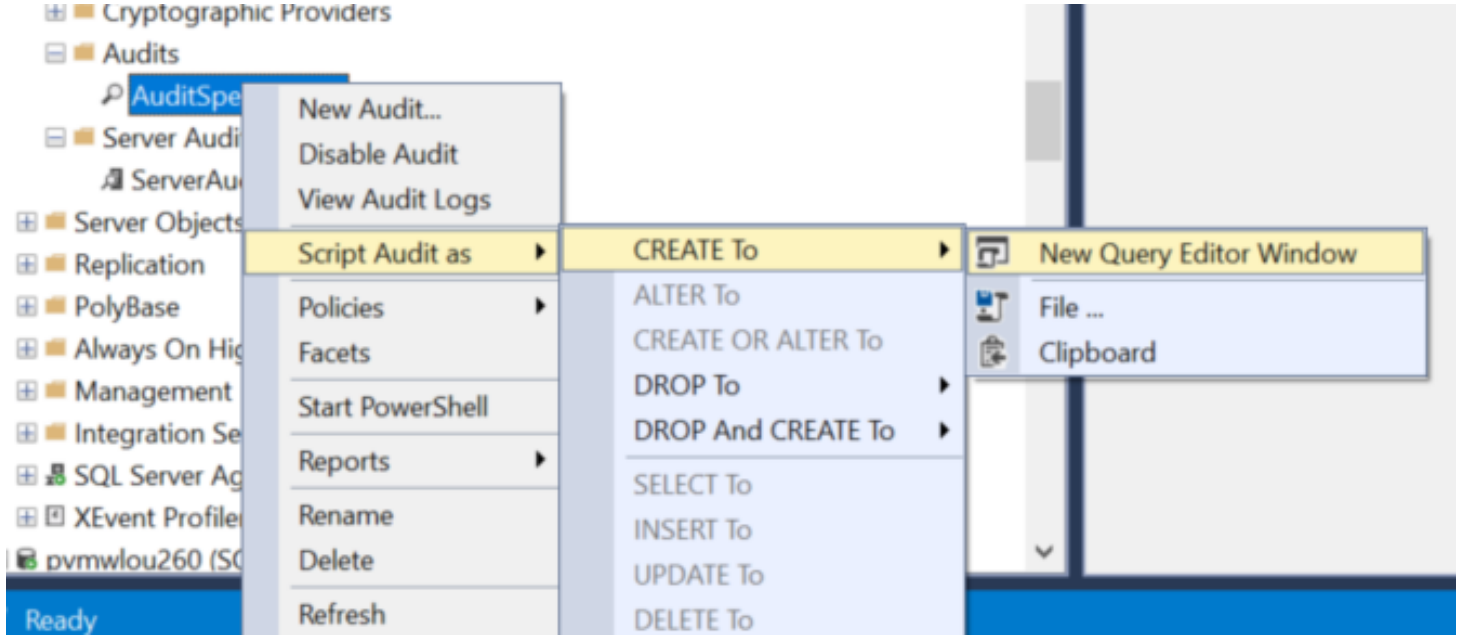
One audit specification (required)

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

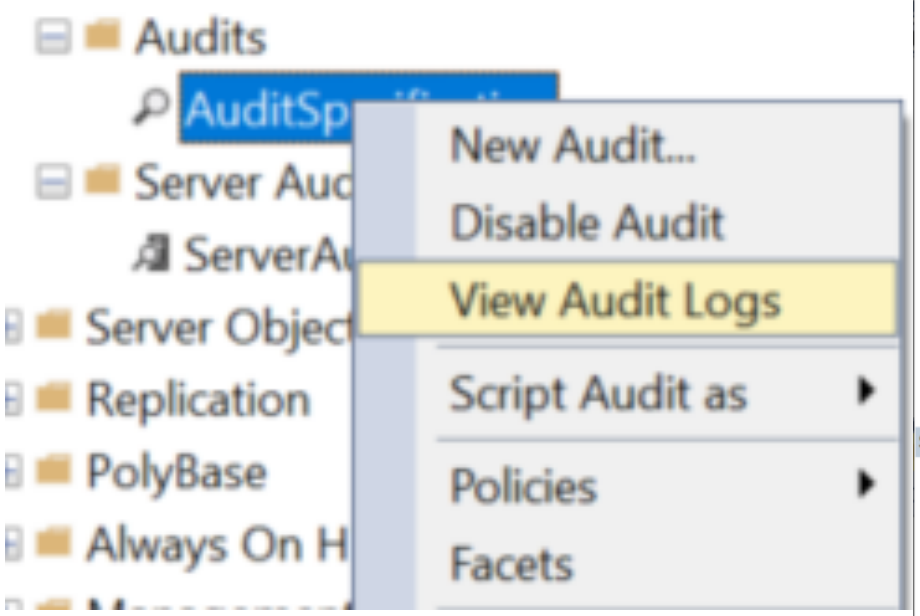
```
USE [auditing]
CREATE DATABASE AUDIT SPECIFICATION [DatabaseAuditSpecification_Auditing]
FOR SERVER AUDIT [AuditSpecification]
ADD (DATABASE_ROLE_MEMBER_CHANGE_GROUP),
ADD (AUDIT_CHANGE_GROUP),
ADD (DBCC_GROUP),
ADD (DATABASE_PERMISSION_CHANGE_GROUP),
ADD (DATABASE_OBJECT_PERMISSION_CHANGE_GROUP),
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)
```

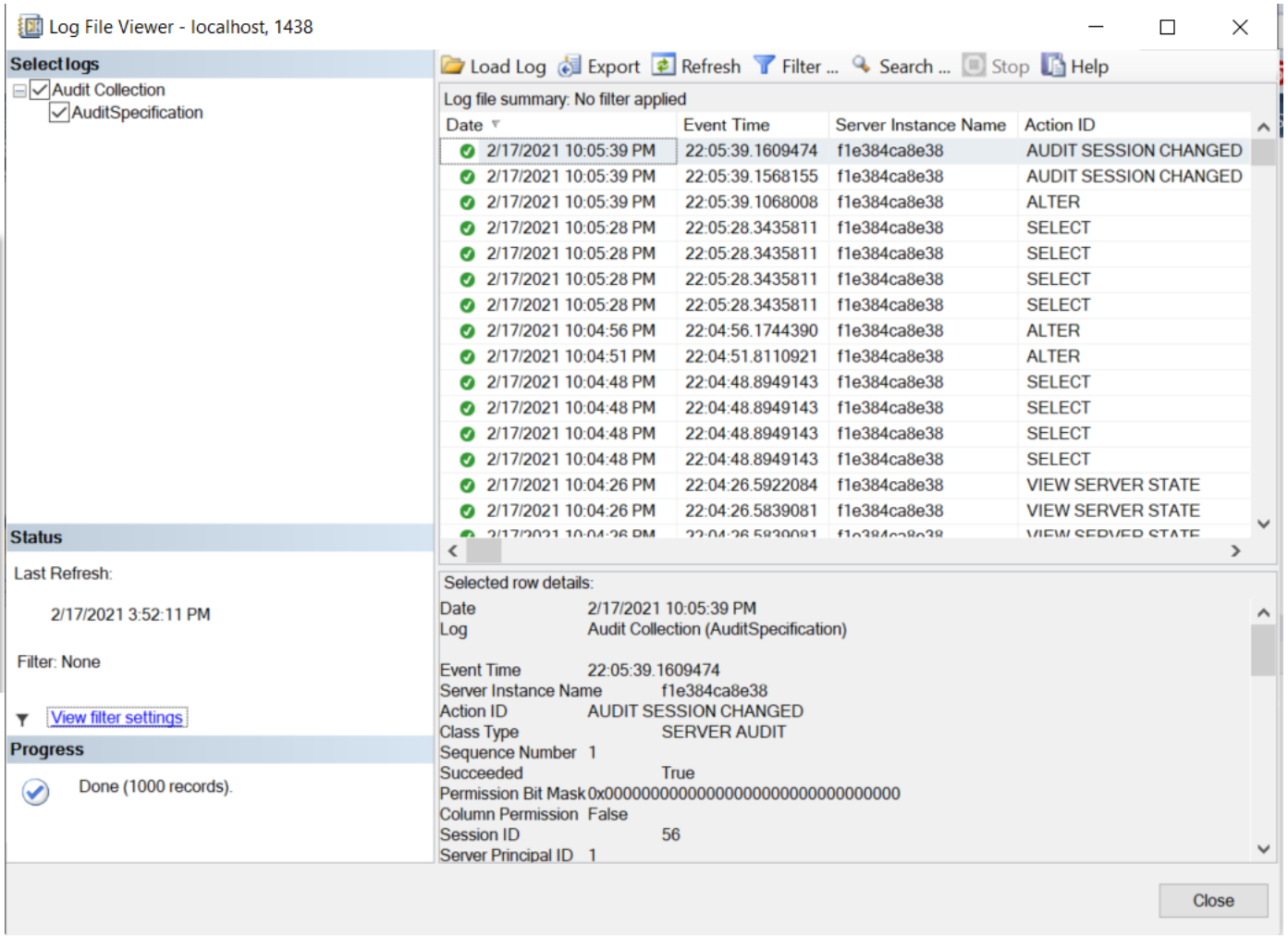
FILTERING SQL SERVER AUDIT

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 GUI





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/*.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 00:12:38.0592305	CREATE	CREATE DATABASE testing	1	ubuntusql1	master		sa

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]='sa' AND [schema_name]<>'sys')
ALTER SERVER AUDIT [Audit-AuditingUser] WITH (STATE = ON)
```

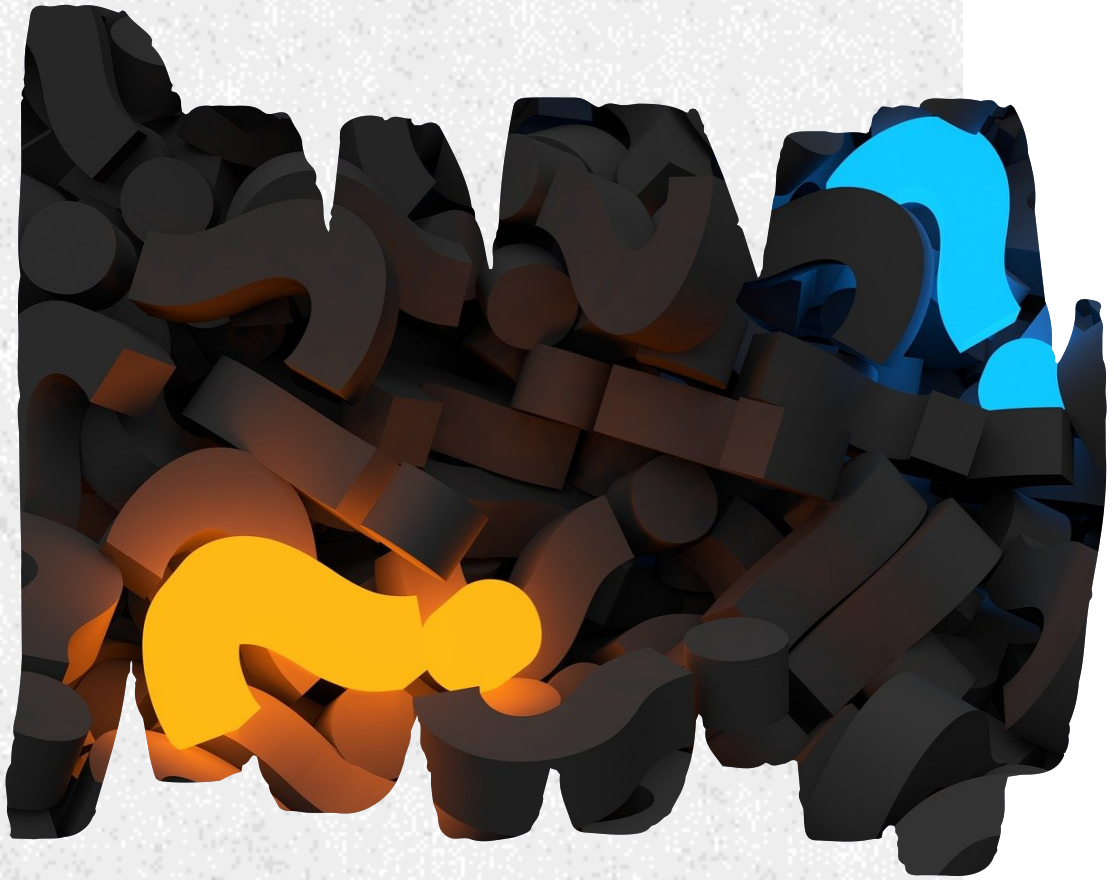
Server audit specification

```
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 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

SQL SERVER AUDITING DEMO

EXTENDED EVENTS PROS AND CONS

Pros

Easy to get started with a templates

Will feel familiar if you used SQL Trace or Profiler

Easy to view live events in SSMS GUI

Cons

Need to know how to query XML if you want to use a SQL query instead of SSMS live event viewer

SQL SERVER AUDIT PROS AND CONS

Pros

Easy to view audit log in SSMS GUI

You don’t need to know how to query XML to query events with a SQL query

Easy to capture specific auditable events or capture all auditable events

Cons

More complicated to setup than Extended Events

No templates to guide you

XEVENTS VS SQL AUDIT

Feature	Extended events	SQL Server audit
Setup via GUI or scripts	Yes	Yes
Query via GUI or scripts	Yes	Yes
Delete in GUI or script and it deletes history	No, xel files are left on disk if disk location is configured	No, audit files are left on disk if disk location is configured
Can delete and modify it while it's enabled and running	Yes	No
Save to locations	event_file as .xel file on disk ring_buffer event_counter histogram pair_matching etw_classic_sync_target	.sqlaudit file on disk Application Log Security Log
Ability to customize number, location, and size of files	Yes	Yes

XEVENTS VS SQL AUDIT

Feature	Extended events	SQL Server audit
Query without parsing XML	No	Yes
Gives you host info about changes made	Yes	Only in SQL Server 2017 and later versions
Templates	Yes	No
Ability to filter what is captured	Yes	Yes
Ability to audit what a user does	Yes	Yes
Ability to capture server metrics like waits stats or connection tracking	Yes	No
Setup multiple on a server	Yes	Yes
Number of items required to make it work	One	Two to three

SPECIFIC USE CASES

What I want to capture	Extended events	SQL Server audit
Audit everything a user does	X	
Audit all the perms and schema changes		X
Audit who's changing a table		X
Audit everything happening in a specific database (be careful with this on busy databases)	X	

DISCLAIMER ON AUDITING

Be very careful how and what you audit

You can overload or freeze up a production server

Less is more

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

Extended events quickstart

https://docs.microsoft.com/en-us/sql/relational-databases/extended-events/quick-start-extended-events-in-sql-server?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

Extended events overview

https://docs.microsoft.com/en-us/sql/relational-databases/extended-events/extended-events?view=sql-server-ver15

Thank you for attending!

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