

Capture Changes with SQL Server's Change Data Capture

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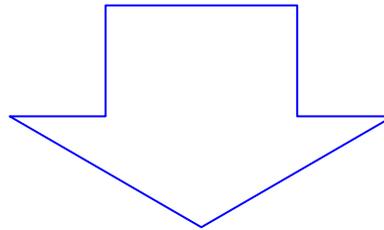
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- Pizza Connoisseur
 - (self proclaimed)

Presentation Summary

Learn how to easily capture information about data changes.

Change Data Capture (CDC) tracks INSERTs, UPDATEs, and DELETEs applied to your SQL Server tables, and then informs you of what changed and when it changed.

In this presentation we'll discuss what is Change Data Capture, how to activate it within SQL Server 2008 or higher, we'll walk through the steps needed to activate it on your database tables and then explore how you can use Change Data Capture to understand how and why your data changed.

Brief History - Tracking Changes

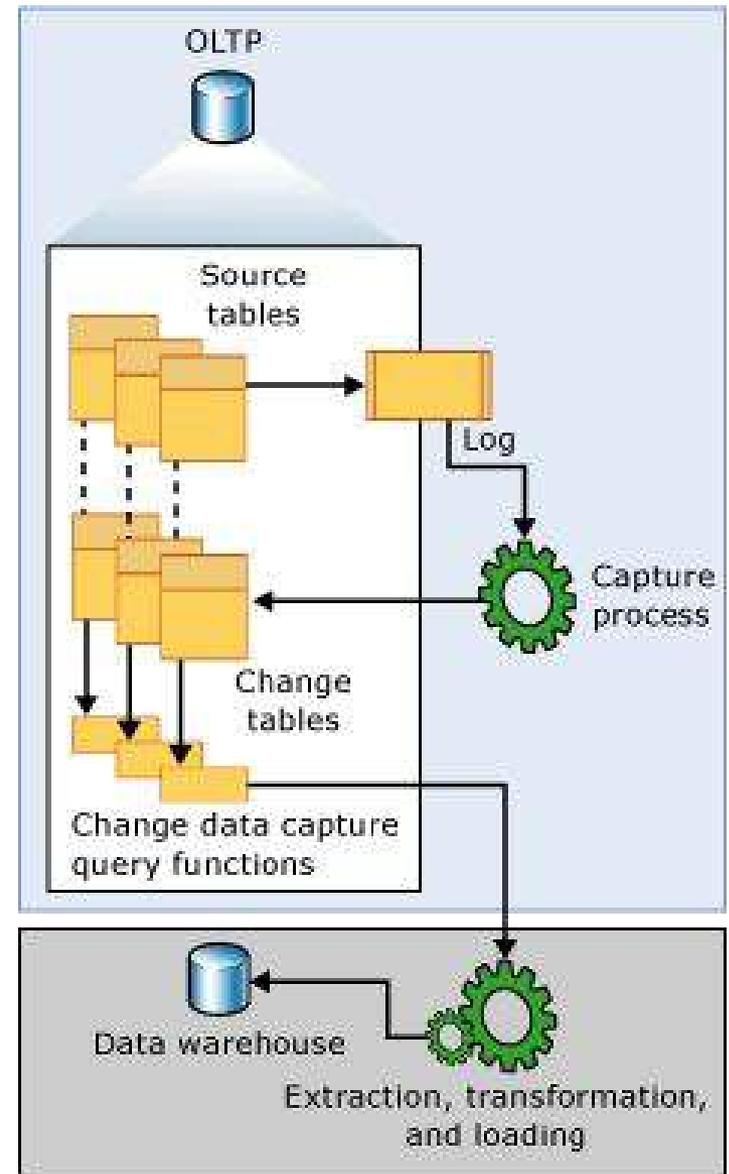
- SQL Server 2005 introduced **triggers**, a new feature, that helped sql professionals track changes in data
 - CREATE TRIGGER: **after update**, **after insert** and **after delete**
- SQL Server 2008 improved on its ability to track changes in data with Change Tracking and Change Data Capture (CDC).
- CDC has allowed SQL Server developers to deliver SQL Server data archiving and capturing without any additional programming.
- CDC is available in Enterprise, Developer and Evaluation editions (for SQL Server 2008 or higher)
 - Also avail in Data Center version of 2008

What is Change Data Capture

- An asynchronous process that records INSERTs, UPDATEs, and DELETEs applied to SQL Server tables
- Enabled at the database and table level
 - New CDC tables are created that store what changed, where, and when
 - Table-valued functions are created to systematically access the change data from the CDC table over a specified range, returning the information in the form of a filtered result set
- Change Data Capture (CDC) vs Change Tracking (CT)
 - Change Tracking detects that a row has changed, lets a process return the latest version of the data from the source table but **does not** track what data was modified
 - Change Data Capture detects that a row has changed as stores all the intermediate changes, as well as the final state of a record

How CDC Works

1. Inserts, updates, and deletes are applied to tracked source tables
2. Info describing the changes are added to the transaction log
3. Capture process reads the logs and sends change info to change tables
4. Functions identify changes over a specified range - displayed as a filtered result set
5. The result set can be used by another process to update related data in another location



Utilizing Change Data Capture

SSMS Demo



Enable CDC at the Database Level

1. Verify whether CDC is already enabled for a database

```
USE master
GO
SELECT [name], database_id, is_cdc_enabled
FROM sys.databases
GO
```

2. Enable CDC for a database

```
USE AdventureWorks2014
GO
EXEC sys.sp_cdc_enable_db
GO
```

After CDC is Enabled

New System Table

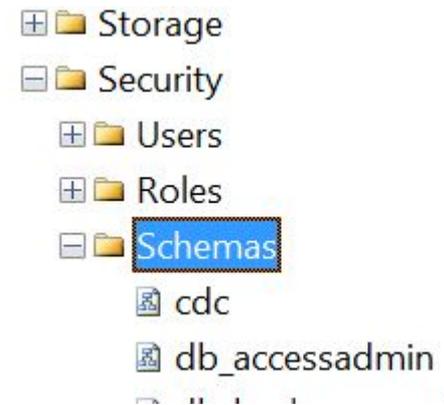
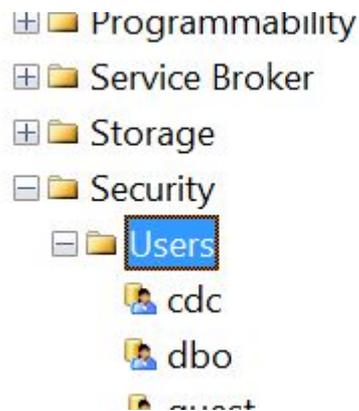
- [-] AdventureWorks2014
 - [+] Database Diagrams
 - [-] Tables
 - [-] System Tables
 - [+] cdc.captured_columns
 - [+] cdc.change_tables
 - [+] cdc.ddl_history
 - [+] cdc.index_columns
 - [+] cdc.lsn_time_mapping
 - [+] dbo.systranschemas
 - [+] FileTables
 - [+] dbo.AWBuildVersion
 - [+] dbo.DatabaseLog
 - [+] dbo.ErrorLog

New Schemas

- [-] AdventureWorks2014
 - [+] Database Diagrams
 - [+] Tables
 - [+] Views
 - [+] Synonyms
 - [+] Programmability
 - [+] Service Broker
 - [+] Storage
 - [-] Security
 - [+] Users
 - [+] Roles
 - [-] Schemas
 - [+] cdc
 - [+] db_accessadmin

Exclusive Use of the CDC Schema and CDC User

- The CDC process will exclusively use a schema named “cdc” and a database user named “cdc”.
- If a schema or a user already exists in the database with this name, then you will not be able to use cdc until you rename or reuse the conflicting object.



Enable CDC at the Table Level

1. Verify whether CDC is already enabled for a table

```
USE AdventureWorks2014
GO
SELECT [name], is_tracked_by_cdc
FROM sys.tables
GO
```

2. Enable CDC for a database

```
USE AdventureWorks2014
GO
EXEC sys.sp_cdc_enable_table
@source_schema = N'HumanResources', @source_name = N'Shift',
@role_name = NULL
GO
```

CDC System Tables

- **cdc.captured_columns**
 - This table returns result for list of captured column.
- **cdc.change_tables**
 - This table returns list of all the tables which are enabled for capture.
- **cdc.ddl_history**
 - This table contains history of all the DDL changes since capture data enabled.
- **cdc.index_columns**
 - This table contains indexes associated with change table.
- **cdc.lsn_time_mapping**
 - This table maps LSN number

New SQL Jobs Created

- **cdc.AdventureWorks2014_capture**
 - Executes system stored procedure `sys.sp_MScdc_capture_job`. The procedure `sys.sp_cdc_scan` is called internally by `sys.sp_MScdc_capture_job`. This procedure cannot be executed explicitly when a change data capture log scan operation is already active or when the database is enabled for transactional replication. This system SP enables SQL Server Agent, which in fact enables Change Data Capture feature.
- **cdc.AdventureWorks2014_cleanup**
 - When this job is executed it runs the system stored procedure `sys.sp_MScdc_cleanup_job`. This system SP cleans up database changes tables.

Change Data Capture w/ Insert Operation

1. View Source and Change tables prior to change

```
USE AdventureWorks2014
GO
SELECT *
FROM HumanResources.Shift
GO

SELECT *
FROM cdc.
HumanResources_Shift_CT
GO
```

2. Insert Operation

```
USE AdventureWorks2014
GO
INSERT INTO [HumanResources].[Shift]
           ([Name],[StartTime],
           [EndTime],[ModifiedDate])
VALUES ('Tracked Shift',
       GETDATE(), GETDATE(),
       GETDATE())
GO
```

Change Data Capture w/ Update Operation

1. View Source and Change tables prior/after change

```
USE AdventureWorks2014
GO
SELECT *
FROM HumanResources.Shift
GO
```

```
SELECT *
FROM cdc.
HumanResources_Shift_CT
GO
```

2. Update Operation

```
USE AdventureWorks2014
GO
UPDATE [HumanResources].
[Shift]
SET Name = 'New Name',
        ModifiedDate = GETDATE()
WHERE ShiftID >= 4
GO
```

Change Data Capture w/ Delete Operation

1. View Source and Change tables prior/after change

```
USE AdventureWorks2014
GO
SELECT *
FROM HumanResources.Shift
GO
```

```
SELECT *
FROM cdc.
HumanResources_Shift_CT
GO
```

2. Delete Operation

```
USE AdventureWorks2014
GO
DELETE FROM [HumanResources].
[Shift]
WHERE ShiftID = 4
GO
```

Reading Interval Change Capture Data

Example 1: Reading changed columns

```
USE AdventureWorks2014
DECLARE @from_lsn binary (10), @to_lsn binary (10)
SET @from_lsn = sys.fn_cdc_get_min_lsn('HumanResources_Shift')
SET @to_lsn = sys.fn_cdc_get_max_lsn()
SELECT *
FROM cdc.fn_cdc_get_all_changes_HumanResources_Shift(@from_lsn,
@to_lsn, 'all')
ORDER BY __$seqval
```

Example 2: Reading changed columns

```
--Use Script "Example 2: Reading changed columns"
```

Reading Interval Change Capture Data (cont)

Example 2: Reading changed columns

```
USE AdventureWorks2014
DECLARE @from_lsn binary (10), @to_lsn binary (10)
SET @from_lsn = sys.fn_cdc_get_min_lsn('HumanResources_Shift')
SET @to_lsn = sys.fn_cdc_get_max_lsn()
SELECT *
FROM cdc.fn_cdc_get_all_changes_HumanResources_Shift(@from_lsn,
@to_lsn, 'all')
ORDER BY __$seqval
```

Viewing and Changing the Default Data Capture Configuration

1. View CDC Job Configurations

```
USE AdventureWorks2014
GO
EXEC sys.sp_cdc_help_jobs
GO
```

2. Change CDC Job Settings

```
USE AdventureWorks2014;
GO
EXECUTE sys.sp_cdc_change_job
@job_type = 'cleanup',
@retention = 86400; --60 days
```

Change Data Capture configuration settings

- **maxtrans*** -- The maximum number of transactions to process in each scan cycle.
- **maxscans*** -- The maximum number of scan cycles to execute in order to extract all rows from the log.
- **continuous*** -- A flag indicating whether the capture job is to run continuously (1), or run in one-time mode (0). For more information, see sys.sp_cdc_add_job (Transact-SQL).*
- **pollinginterval*** -- The number of seconds between log scan cycles.
- **retention**** -- The number of minutes that change rows are to be retained in change tables.
- **threshold** -- The maximum number of delete entries that can be deleted using a single statement on cleanup.

* *Valid only for capture jobs*

***Valid only for cleanup jobs*

Disable CDC Feature on Table

1. Get Capture_Instance Name

```
USE AdventureWorks2014;  
GO  
EXEC sys.  
sp_cdc_help_change_data_captur  
e  
GO
```

2. Deactivate CDC

```
USE AdventureWorks2014;  
GO  
EXECUTE sys.  
sp_cdc_disable_table  
    @source_schema =  
N'HumanResources',  
    @source_name = N'Shift',  
    @capture_instance =  
N'HumanResources_Shift';  
GO
```

Disable CDC Feature on Database

The Following T-SQL query will disable CDC on the entire database

```
USE AdventureWorks2014
GO
EXEC sys.sp_cdc_disable_db
GO
```

Note: Executing this Stored Procedure will delete all the data, functions, tables related to CDC.

Resources

- **Change Data Capture**
 - [https://technet.microsoft.com/en-us/library/bb522489\(v=sql.105\).aspx](https://technet.microsoft.com/en-us/library/bb522489(v=sql.105).aspx)
- **About Change Data Capture (SQL Server)**
 - [https://msdn.microsoft.com/en-us/library/cc645937\(v=sql.120\).aspx](https://msdn.microsoft.com/en-us/library/cc645937(v=sql.120).aspx)
- **Tuning the Performance of Change Data Capture**
 - [https://technet.microsoft.com/en-us/library/bb522489\(v=sql.105\).aspx](https://technet.microsoft.com/en-us/library/bb522489(v=sql.105).aspx)
- **SQL Server Evaluation Downloads**
 - SQL Server 2012: <https://www.microsoft.com/en-us/download/details.aspx?id=29066>
 - SQL Server 2014: <https://www.microsoft.com/en-us/evalcenter/evaluate-sql-server-2014>

Thank You

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