How To Use Cache Framework

An Open Source Asset for use with TIBCO® Data Virtualization

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Purpose	Developer Guide

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Revision History

Version	Date	Author	Comments
0.1	09/07/2010	Calvin Goodrich	Initial revision
0.2	03/06/2013	Calvin Goodrich	Updated to take advantage of the incremental caching framework of CIS 6.2.1
0.3	05/13/2014	Calvin Goodrich	Updated to reflect collection of AS tools and utilities into /shared/ASAssets
1.0	11/04/2014	Mike Tinius	Created the Cache Framework
1.1	11/20/2014	Mike Tinius	Added supported for SQL Server 2008 cache database. Added copyright text.
1.2	02/09/2015	Mike Tinius	Fixed path issue with copy privileges. Fixed issue with view resources always being created in upper case. Allows for mixed case views and DB resources. Reduced number of INFO statements by changing 2nd and 3rd tier to DEBUG statements.
1.3	12/014/2017	Mike Tinius	Transitioned to Tibco for release 2017Q4
2018Q1	March 2018	Mike Tinius	Updated to use introspectResources.
2019Q300	07/15/2019	Mike Tinius	Added MemSql and Postgres Support. Added ability to migrate cached views into the cache framework. Added ability for DeployCache to only rebuild the cache tables if they don't exist or have been modified otherwise do nothing. Modified all custom function references to explicit paths. Requires Utilities 2019Q200. Deprecated and removed the use of 2 pre-callback implementation and post-callback implementation procedures in order to simplify. Now only a single pre and post callback procedure is maintained. Deprecated and removed Constants variables [ApplicationCacheProcImplPath, DefaultPreCallbackImplSuffix, DefaultPostCallbackImplSuffix]. Added incremental cache attributes INCR_INITIAL_LOAD_SCRIPT and INCR_DELTA_LOAD_SCRIPT to track the location of those scripts.
2019Q301	08/01/2019	Mike Tinius	Modified all occurrences of getConstant to getConstantV2. Deprecating getConstant.
2019Q302	08/20/2019	Mike Tinius	Modified /Scripts/PublishedImpl/CachingDataModifyScript • Fixed bug to correctly detect the last usage of getConstant in the script text.

			• Added code to modify CachingData and change getConstant function to the fully qualified getConstantV2. Modified /Scripts/PublishedImpl/DeconfigureCache • Fixed a bug to not throw an exception if the call back scripts are not found but expected to be there. Added new procedure "ConfigureCache_Multi_Table" in each template to automatically add an entry into CachingData and configure the cache in one invocation using multi-table caching. Ease of use.
2020Q100	01/03/2020	Mike Tinius	Various Bug Fixes

Related Documents

Name	Version
How To Use Utilities.pdf	2019Q301

Supported Versions

Name	Version
TIBCO® Data Virtualization	7.0 or later
AS Assets Utilities open source	2019Q301 or later

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1 Introduction

Purpose

Data Virtualization (DV) 7.0 / 8.x, features a framework to support the development of custom full and pull-based incremental caching solutions. This document describes such a solution developed in the field by the Professional Services Group (PSG) team. At this time, it only supports full and incremental caching of resources of views or tables (procedure output is not supported.)

It is highly recommended to acquire Tibco PSG help to implement the Cache Framework. Do not contact Tibco Support for any Tibco Open Source code.

Audience

This document is intended to provide guidance for the following users:

- Architects.
- Developers.
- Administrators.

References

Product references are shown below. Any references to CIS or DV refer to the current TIBCO® Data Virtualization.

- TIBCO® Data Virtualization was formerly known as
  - Cisco Data Virtualization (DV)
  - Composite Information Server (CIS)

2 Overview

Caching Overview

Caching in DV is the materialization of a resource (either view, table, or stored procedure) and storing of the materialized data in an external database or flat file (similar to the way a Materialized View operates in an Oracle database.) Resources in DV are configured to store materialized data in one or more tables in a relational data source. Once the basic configuration is done, a number of options exist as to when and/or how often a resource's cache is refreshed. However, this refresh is a full refresh of the entire data set every time a refresh is run (meaning an entirely new result set is loaded into the cache data table, after which old result sets from any previous refreshes are removed.)

Full Caching

Full caching is a method of updating all the cache data with the current set of rows from the source(s) of record. Each time the refresh is done it pulls all of the data. This works efficiently for relatively small data sets. It also works the best when caching complex views in the Business or Application layer of the Data Abstraction best practices as those views typically do not yield multi-million row tables. Additionally, due to complexities of joins it may not be possible to implement an incremental cache strategy due to conflicting keys.

Incremental Caching

Incremental caching is a method of updating existing cache data with new, updated, or deleted rows from the source(s) of record.

Push-based incremental caching involves being notified of changes by an application or change data capture mechanism and updating the cache data as source data changes. The requirements and setup for this within DV are described in Appendix F of the DV User's Guide.

Pull-based incremental caching (which is the implementation that this document discusses) is more of a batch-oriented process where a refresh is initiated in DV and a mechanism detects what data has changed since the last cache refresh (full or incremental) and applies those changes to the cache data as a single transaction.

There are a number of ways to detect change in data, including scraping database transaction logs, attaching CRUD triggers to database tables, and using a combination of columns to indicate when a row was last inserted, updated or deleted (deleted row data may also be stored in a separate table altogether.)

In this solution, two methods of detecting data change are supported "out of the box":

- One or more "last updated" columns and, for those tables that track it, a separate table of deleted rows to indicate when data was deleted. Also, a way of uniquely identifying each row in the cache data table (with either an actual or logical primary key) is required.
- A separate “delta” table is maintained by the updating application indicating what changes have taken place in the underlying data. This table contains only one record for each corresponding record in the underlying data with an extra column indicating what the last operation was. For example, when a delta row is inserted, the last operation is indicated by a value of ‘C’. When the underlying data is updated, the delta row is updated (instead of a second row being inserted) with the last operation changed to ‘U’. Again, a way of uniquely identifying each row in the cache data table is required.

Either of these methods may be altered / updated to fit other types of data change detection.

Caching Data Source Targets

The cache management framework currently supports the following cache target databases:

- Oracle 11g, 12c
- SQL Server 2008, 2012
- Netezza 7 [Merge not supported therefore only inserts are supported.]
- MemSql
- Postgres 9.1
- Other databases can be supported by engaging a Professional Services engineer. Depending on the requirements, it could take 2-4 weeks to do the port and test. Appendix D provides the background on what is required and what will be done.

Unsupported Features

The following features are not currently implemented.

Partitioned Incremental Caching

Partitioned incremental caching is similar to incremental caching, but instead of caching the entire data set, only part of the data is cached and the rest of the data is accessed from the original system(s) of record on demand.

As an example, the cost to cache over 100 years of data cannot be justified when older data will be infrequently accessed. For this reason, a view of such data can be partitioned in such a way that only the most recent data is cached. To implement partitioned caching, some additional components are needed to allow a user to seamlessly and transparently query data from both halves of the partitioned data.

In the current solution, the partitioning is accomplished using a named "activity date" column and the newer data is cached. With some tweaking of the code, this behavior can be altered to fit other partitioning needs.

Historical

Historical data refers to system of record data that was cached but is no longer available in the system of record. This type of data can be transient in nature where it only lives for a short period of time in the system of record. It may also be data that gets purged from the system of record over a period of time. Currently the Cache Framework has no way of handling the backup of this historical data in the event of a deployment that is failed on an incremental cache. Currently, the Cache Framework must be able to recover a full cache refresh from the system of record in the event of a failed cache deployment or failed refresh for an incremental cache.

Schema Differences

Currently, the Cache Framework can only support the same cache database data source name, catalog name and schema name in all deployment environments. In other words, the DV path must be exactly the same in all environments. The issue is that when the DV path to the cache database is different in the target deployed environment, it causes the cache to be marked as failed. For incremental caches, this is not the desired behavior as this invalidates the cache.

Caching Terms

1) Cache Target – The cache target is one of the supported cache databases.
2) Application – The application refers to the business line, business area or subject area in which the cache framework will be applied. There is one cache target database per application.
3) Context – All procedures within the cache framework are executed using the context of the “constants” procedure which defines the application paths and cache database to be used.
    a. Additionally, the context is important from a deployment perspective as the CACHING_DATA table is used to track the views to be cached for a given application.
    b. All audit log entries are saved with the context of the organization name and application name.

Business Requirements

The primary requirement is to create a virtual data model using the Data Virtualization (DV) layer. This data model federates and virtualizes data from various data sources servicing specific business areas.

As part of the primary requirements, the virtual model should be able to provide historical information of various source tables. Since all sources of data do not store history, therefore history should to be maintained in DV layer.

Therefore, the caching framework should be able to configure caching on resources

- that are cached in traditional method to improve performance, where traditional approach requires overwrite complete record sets for each cache cycle, or
- configure resources that are cached incrementally to build history.

Technical Requirements

1) Provide a generic cache framework that supports various databases for cache targets.
2) Support the following cache types for code generation
    a. ***Incremental*** (no staging) – incrementally acquire newly inserted rows.
    b. ***Full single table*** (uses cachekey) – refresh full cache to a single table.
    c. ***Full multi-table*** (no cachekey) – refresh full cache to a round-robin of multiple tables.
    d. ***Hybrid*** (incremental + staging)
    e. ***Merge*** – ability to merge inserts/updates/deletes from source into incremental cache.
    f. ***Rolling window*** – Purges data that falls outside the window. Need to define purge window and frequency of purge.
    g. ***Partition*** – ability to reference a cache and live partition at the same time. [*Future*]
3) Support the following cache features
    a. Distribution columns for Netezza
    b. Drop/Create indexes
    c. Execute table statistics
    d. Migrate non-cache framework views into the cache framework.
    e. Initial/Delta load procedures for incremental refresh.
    f. Pre- and Post-cache procedure execution for full-table and multi-table refresh.

g. Native column options are appended at the end of the column list as in CREATE TABLE tablename (column-list, **column-options**) table-options.
h. Native table options are appended after the create statement as in CREATE TABLE tablename (column-list, column-options) **table-options**.
i. Native index options options are appended after the create index as in CREATE INDEX indexname ON tablename (column-list) **index-options**.
j. Cache Schedule (Manual and Scheduled)
    i. Create cache schedule using period within view
    ii. Create separate trigger to execute “RefreshCache” procedure
    iii. Cache policies can be used with full cache only.

4) Provide a general audit logging framework to correlate messages.
5) Ability to initialize the framework
6) Ability to de-configure a cache resource
7) Ability to deploy a cache resource or all resources by deploying the CachingData procedure along with the cached resources.
    a. Views are not deployed if the all cache resources exist and the view and cache table signatures match. Only deploy cache framework views if necessary.

3 Installation

Requirements for Installation

- Data Virtualization 7.0 with Service Pack 1 or higher installed.
- Data Virtualization 8.0 or higher
- AS Development Utilities version 2019Q301 [Utilities_2019Q301.car] installed.
- A cache database must be created, introspected, and configured for caching. This means that:
    a. ***Cache status and cache tracking tables should be created and configured on the cache target data source connection***.
    b. The cache target data source user credentials must have privileges to
        i. Create, drop and get sequences
        ii. Create and drop indexes
        iii. Create and drop tables
        iv. Execute table statistics

Installation Steps

- If an existing Cache Management folder exists in both /shared/ASAssets/CacheManagement and /services/databases/ASAssets/CacheManagement, take a backup export before you begin.
    - Select each folder using control-click and export both CacheManagement folders to a single backup car file.
- Import Cache Framework base code with overwrite which will wipe out any existing code.
    - Background of what gets imported:
        - When the cache framework solution is imported, the structure `/shared/ASAssets/CacheManagement/CacheFramework` is created. In the rest of this document `<CF_Folder>` will be used to reference this location.
        - When the cache framework virtual database is imported, the structure `/services/databases/ASAssets/CacheManagement/CacheFramework` is created. In the rest of this document `<CDB_Folder>` will be used to reference this location.

- [1] Create the published database “ASAssets” if it does not exist: `/services/databases/ASAssets`
- [2] Right click on the root folder `(/) or "Desktop (username)"` and import “with overwrite” the cache framework solution `CacheFramework_2020Q100.car`.
  - This will include the /shared/ASAssets/CacheManagement/CacheFramework and /services/databases/ASAssets/CacheManagement

- (Optional) Import Cache Framework sample code
  - Background of what gets imported:
    - When the cache framework sample is imported, the structure `/shared/ASAssets/CacheManagement/CacheFrameworkSample` is created. In the rest of this document `<CS_Folder>` will be used to reference this location.
  - [1] If you have previously modified the CacheFrameworkSample resources then back them up first.
  - [2] There are 2 options for importing samples.
    - Import (2a) all of the sample code or import (2b) selected ones. Decide which option below to do.
  - [2a] (Option 1) To import “ALL” samples right click on the root folder `(/) or "Desktop (username)"` and import “with overwrite”
    - [2a.1] Right click on the root folder `(/) or "Desktop (username)"` and import “with overwrite” the ***ALL*** cache framework sample solution `CacheFrameworkSample_ALL_2020Q100.car`.
  - [2b] (Option 2) To import selected samples follow these steps:
    - [2b.1] Right click on the root folder `(/) or "Desktop (username)"` and import “with overwrite” the ***Netezza*** cache framework sample solution `CacheFrameworkSample_Netezza_2020Q100.car`.
    - [2b.2] Right click on the root folder `(/) or "Desktop (username)"` and import “with overwrite” the ***Oracle*** cache framework sample solution `CacheFrameworkSample_Oracle_2020Q100.car`.

- [2b.3] Right click on the root folder `(/) or "Desktop (username)"` and import "with overwrite" the ***SQL Server*** cache framework sample solution `CacheFrameworkSample_SqlServer_2020Q100.car`.
- [2b.4] Right click on the root folder `(/) or "Desktop (username)"` and import "with overwrite" the ***MemSql*** cache framework sample solution `CacheFrameworkSample_MemSql_2020Q100.car`.
- [2b.5] Right click on the root folder `(/) or "Desktop (username)"` and import "with overwrite" the ***Postgres*** cache framework sample solution `CacheFrameworkSample_Postgres_2020Q100.car`.

- Set privileges
  - [1] Set privileges on `/shared/ASAssets/CacheManagement` for the group "**all/composite**" as READ EXECUTE SELECT and push down recursively as "make child resources look like this resource".
  - [2] Set privileges on `/services/databases/ASAssets/CacheManagement` for the group "**all/composite**" as READ EXECUTE SELECT and push down recursively as "make child resources look like this resource".
- Initialize the administrative interface database. This is a DV internal data source that is used to point back to DV.
  - Open the data source located at `<CF_Folder>/Scripts/AdminInterface/CIS_Internal` and modify the connection parameters to point back to the DV server that the scripts are installed on. Use an admin user who has rights to execute and copy privileges. Typically, all you need to do is change the port and password for "admin" or provide an equivalent admin type of user.
- Proceed to "Configuring an Application Template" to configuring the cache scripts.
- Proceed to "Configuring the Cache Framework Sample" for configuring the sample.
- If not using one of the supported databases as a caching database, please contact your PSG account manager to engage the services of a PSG engineer who may be able to update the solution to use your caching database type.

4 Configure Cache Framework

The following is a discussion on how to configure a view using the cache framework.

Introduction

The concept of porting an application template is to provide the ability to generate and deploy DV cache objects. The application template provides all of the necessary hooks into the generic framework code for implementing and deploying cache resources. It is important to understand that the application sets the context. There are different perspectives that can be considered when defining the context.

1) *Subject Area context* – Conceptually, this is the better choice irrespective of whether there is one cache database or multiple. By having an application configured for each subject area, it allows the audit log messages to be customized with same "*Organization Name*" and "*Application Name*". In this scenario, the application will only see their audit log messages because the other messages are filtered out. It also allows the application users to control their own list of cache resources separate from other applications within the CACHING_DATA table.
2) *Target cache database context* – Technically speaking only one context is required for each cache database being referenced in DV. This is true because the paths to the cache database are referenced in the "Constants" procedure. However, this also means that all audit log messages will have the same Organization and Application Name and the list of cache resources will be within a single context thus there is no way to separate out the notion of different subjects.
3) It is strongly advised that the view to be cache have a primary key index created on it (that includes the cache key column.) In any case, a column or combination of columns is required in order to uniquely identify a row of cached data.
4) If the "last updated" type of incremental caching is going to be used, then an index on the "last updated" column(s) would be advisable as well.

Configuring an Application Template

Configuring a template is a one-time action that should be done by a DV architect with overall knowledge of the application and cache database target.

1) Copy the application template applicable for your cache database type:
    a. Oracle: `<CF_Folder>`/ApplicationTemplateOracle

b. SQL Server: <CF_Folder>/ApplicationTemplateSqlServer

c. Netezza: <CF_Folder>/ApplicationTemplateNetezza

d. MemSql: <CF_Folder>/ApplicationTemplateMemSql

e. Postgres: <CF_Folder>/ApplicationTemplatePostgres

f. Copy and paste the folder into your own application project folder.

   i. Resources will automatically rebind to your folder location.

   ii. It is “highly” recommended to copy the cache framework template within the top-level project folder so that the correct privileges are “pushed” down from that project folder allowing the developers to be able to execute the necessary API’s. Additionally, the cache framework may create additional resources such as callback scripts, load scripts and staging views that all require proper privileges for users to be execute.

g. Rename the target “TG” folder to meet your needs which shall be known as <TG_Folder> throughout this document. For example, ApplicationTemplateOracle becomes CacheOracleApplication or whatever name it is given.

2) Modify constants

a. Location: <TG_Folder>/Constants/***constants***

b. Minimum constants to modify:

   i. ***ApplicationBasePathConstant*** – the full path of your new application template folder.

   ii. ***DEBUG_LEVEL*** – Set for DEBUG_LEVEL_INFO but it is recommended to set it to DEBUG_LEVEL_DEBUG until you are comfortable with how everything is working.

   iii. ***DEBUG_LOGGING_TYPE*** – Set to save to DB (AUDIT_LOG) and PRINT to the command line. Remove PRINT to disable printing to command line.

   iv. ***OrganizationName*** – The organization such as “MyOrganization”

   v. ***ApplicationName*** – Your application name. Recommend staying with architectural concepts such as Business Line/Business Area/Subject Area so that audit log messages can be correlated with folders in DV. Functional concept. The AUDIT_LOG table may be shared across various organizations and applications when they are using the same cache database.

   vi. ***ApplicationScriptsBasePath*** – The DV scripts base path for this application. Developer must have privileges to create and delete resources. The default is ApplicationBasePathConstant|| '/Scripts'

but it could be a hard-coded path. It is recommended that it be inside the project folder so that privileges can be applied appropriately.

vii. ***ApplicationPkgQryTempDS*** – The DV cache data source path to rebind the packaged queries to. This is the default ApplicationPkgQryPath || '/TEMP_DS' but it is recommended to set this path to your cache data source path.

viii. ***DefaultCacheDSPath*** – The DV path to the cache data source. Set the actual path to the data source.

ix. ***DefaultCacheDSCatalogName*** – The name of the catalog if applicable or NULL. For example, SQL Server will require a catalog.

x. ***DefaultCacheDSSchemaName*** – The name of the schema if applicable or NULL. For example, MemSql is null.

xi. All other variables are optional and can be configured as needed. Some examples to consider otherwise use the defaults as they are set in the Constants procedure.

1. ***DefaultCacheTablePrefix*** – NULL or short string like 'C_' to signify a cache database table prefix
2. ***DefaultStageTablePrefix*** – A short string value such as 'S_' or 'STG_' to signify a staging table prefix.
3. ***DefaultCacheTableSuffix*** – NULL or short string like '_C' to signify a cache database table suffix. This is not recommended.
4. ***cachePollingInterval*** – Currently set to 5000 milliseconds which is 5 seconds. Frequency (in ms) to poll for the cache refresh outcome.

3) Initialize All Scripts

a. Note: This only needs to be done during the initial configuration of the Cache Framework application template scripts.

b. Location: `<TG_Folder>`/Initialize

c. ***_Execute_All_Scripts*** – This will execute all initialization scripts in order.

i. ***CAUTION***:

1. If multiple “application” folders are sharing the same cache database, then this initialization step only should be done once for the configuration of the first application. Any subsequent execution of these scripts will result in dropping and recreating existing database objects and thus “DELETING” other application metadata.

2. If this is the case, then only execute the "RebindPackagedQueries" script for each new cache application folder that uses the same cache database as other applications.

ii. Input: Drop_Tables_Before_Creating

1. 1=drop table/sequence before creating.
2. 0=do not drop table/sequence before creating

d. **Note: The above script will execute the following individual scripts**:

i. Rebind the packaged queries to your cache data source

1. Location: `<TG_Folder>`/Initialize
2. ***RebindPackagedQueries*** – Execute to rebind the two packaged queries found in /PackageQueryDDLScripts. There are no input parameters. The information for rebinding is contained within the Constants procedure.
    a. ExecuteDDL (all cache database types)
    b. GetIntResult (all cache database types)
    c. ShowIndexes (MemSql)
    d. ShowTables (MemSql)

ii. Initialize database tables and Sequence

1. ***CAUTION***:
    a. If multiple "application" folders are sharing the same cache database, then this initialization step only has to be done once for the configuration of the first application. Any subsequent execution of these scripts will result in dropping and recreating existing database objects and thus "DELETING" other application metadata.
2. Location: `<TG_Folder>`/Initialize
3. Database privileges required:
    a. Create/Drop Sequence
    b. Create/Drop Table
    c. Create/Drop Index
4. ***CreateDBSequence*** : Create DB sequence CACHE_FRAMEWORK_SEQ. Does not drop automatically.
5. ***Create_AUDIT_LOG*** : Will automatically drop if exists.

6. ***Create_AUDIT_LOG_SEQ*** : Will automatically drop if exists.
7. ***Create_CACHING_DATA*** : Will automatically drop if exists.
8. About DROP – Use these if you want to decommission the Cache Framework entirely from a target cache database.
    a. Drop_CACHING_DATA : Drop CACHING_DATA table
    b. Drop_AUDIT_LOG_SEQ : Drop AUDIT_LOG_SEQ table
    c. Drop_AUDIT_LOG : Drop AUDIT_LOG table
    d. DropDBSequence : Drop the DB sequence CACHE_FRAMEWORK_SEQ

4) Migrate pre-existing cached views [optional]
    a. Location: `<TG_Folder>`/Execute
    b. ***MigrateCachedViews*** – This script provides a way to migrate views into the Cache Framework that are not under the control of the Cache Framework. Being under control of the Cache Framework means having a row in the CACHING_DATA table for each cached view and an equivalent row in the "CachingData" procedure.
        i. Given a starting path, this procedure will interrogate each view and determine if it is currently in the Cache Framework or not. If not, it will add the view to the Cache Framework. Alternatively, the user may point directly to a cached view and only bring in that one view into the Cache Framework.
        ii. After completion of this procedure, if there are views that you do not want in the Cache Framework, then remove them from the "CachingData" procedure and execute "CachingData_Insert" to remove and insert the remainder of the views in "CachingData".
5) Modify CachingData procedure
    a. Location: `<TG_Folder>`/DataScripts
    b. ***CachingData*** – A way to track and configure the list of cached views that are controlled by the Cache Framework.
        i. CachingData is a portability mechanism. It is used as a way to migrate the known list of views in the Cache Framework to an upper environment. Anytime a new view is brought into the cache framework and then migrated to an upper environment, the CachingData procedure should also be exported and migrated. This procedure will work in conjunction with DeployCache in the upper enviroments.

ii. Migrate cached views into the Cache Framework will automatically modify the CachingData procedure and update the CACHING_DATA database table.

iii. ConfigureCache_Multi_Table will automatically modify the CachingData procedure and update the CACHING_DATA database table as it configures the view for multi-table and a pre-callback and post-callback procedure.

iv. After manually editing CachingData, execute CachingData_Insert to update the CACHING_DATA database table.

v. Details on configuration settings can be found in the header of the "CachingData" procedure or in the section of the document: "Cache Framework Features and Attributes".

c. ***CachingData_Insert*** – Execute to load rows into CACHING_DATA table from the CachingData procedure.

i. Parameter: 0=Delete and insert only the rows found in CachingData procedure. 1=Delete all rows and then insert CachingData. In both cases, the delete and insert is done in the context of Organization Name and Application Name.

6) Configure the Cache

a. Location: `<TG_Folder>`/Execute

b. ***ConfigureCache*** – Use in conjunction with CACHING_DATA table.

i. Leave inResourcePath blank to configure all views specified in CACHING_DATA or enter a specific resource path to configure only that one.

ii. **Important**: If a view is already cached and you execute ConfigureCache, it will drop all resources and rebuild the cache thus wiping out all of the data.

iii. Use a wildcard "%" at the end of the path to signify any text matching the text preceding the wildcard symbol "%".

c. ***ConfigureCacheAdhoc*** – Use when needing to configure a cache in an adhoc way and don't use CACHING_DATA table.

i. Must supply all parameters for this procedure that would normally be supplied via CACHING_DATA.

ii. This capability bypasses both CachingData procedure and CACHING_DATA database table and does not save any of the cache metadata into the Cache Framework. Once the cache is created, it will not be under the control of the Cache Framework. Therefore, capabilities like DeployCache will not be able to be used.

d. ***ConfigureCache_Multi_Table*** – Auto-configure CACHING_DATA table and view at the same time for multi-table caching.
    i. For inResourcePath provide the full path to the view to be configured for multi-table caching.
    ii. **Important**: If a view is already cached and you execute ConfigureCache, it will drop all resources and rebuild the cache thus wiping out all of the data.
    iii. Wildcards are not permitted in the path. Only one view at a time may be configured.
    iv. It configures the view for three cache tables.
    v. It configures the view for a pre-callback and post-callback procedure.
    vi. It configures the view to automatically drop and create indexes during a refresh.
    vii. It does not configure a trigger or cache schedule.

7) View of AUDIT_LOG
    a. Location: `<TG_Folder>`/Execute
    b. ***AuditLogDisplay*** – Displays the results of AUDIT_LOG for your "*Organization Name*" and "*Application Name*" in descending order or so the latest message is displayed first. It filters out other organizations and applications.
8) Refresh the cache
    a. Location: `<TG_Folder>`/Execute
    b. ***RefreshCache*** – Enter the path of the view to refresh.
    c. Run AuditLogDisplay to view AUDIT_LOG
9) De-configure the cache
    a. Location: `<TG_Folder>`/Execute
    b. ***Deconfigure*** – De-configure a cache or list of cache resources found in CACHING_DATA.
        i. It is recommended to test that this works on one configured view.
        ii. Enter the deleteCachingDataEntry value.
            1. 0=Do not delete the CachingData procedure entry and the CACHING_DATA table entry.
            2. 1=Delete the CachingData procedure entry and the CACHING_DATA table entry.
        iii. Enter the path of the view to de-configure.

1. If left NULL, then de-configure all cache resources found in CACHING_DATA filtered by Organization Name and Application Name.

iv. Run AuditLogDisplay to view AUDIT_LOG

10)Deploy the cache

a. Location: <TG_Folder>/Execute

b. ***DeployCache*** – This script is the main driver script for deploying cache views and tables.

i. ***Assumptions***: The CachingData procedure contains a catalog of all of the cached views. It must be exported (migrated) to the upper environments in order for DeployCache to know what it can deploy from the catalog and how those cached views are configured.

c. The script performs the following:

i. Execute the CachingData_Insert procedure to insert CachingData() rows into CACHING_DATA table

ii. The script determines if the cache needs to be deployed based on whether cache tables exist in TDV and the generated view DDL columns and types matches the cache table columns and types excluding the cachekey column if it exists. If deploy cache then perform the following:
1. Disable the cache views according to CACHING_DATA query
2. Invoke ConfigureCacheScript to create the tables but don't configure the views
3. Update impacted resources
4. Enable the cache views according to CACHING_DATA query

iii. Input: inResourcePath
1. The specific view path to be configured or leave null to configure all views in CachingData (procedure) / CACHING_DATA (table). NOTE: It is recommended to test that this works on one configured view.
2. This path acts as a filter for what is already configured in CACHING_DATA so the view must have already been configured in CACHING_DATA.
3. Use a wildcard "%" at the end of the path to signify any text matching the text preceding the wildcard symbol "%".
4. If a container path is passed in with no wildcard "%", then the wildcard will be added automatically so that only view paths within this path range are deployed if applicable.

d. Run AuditLogDisplay to view AUDIT_LOG

5 Cache Framework Features

The following is a discussion on cache framework features.

Log to a generic audit table script

1) Supported and tested for all cache database targets.
2) cfLog – the main logging procedure invoked by all cache framework procedures. This procedure provides the framework for the various debug levels. This procedure is an interface procedure and does not implement the actual logging itself.
3) The generic “auditLogger” script is the implementation for the different debug logging types.
4) Debug Levels implemented
    a. Various procedures in the Cache Framework implement different levels as shown below. The user can control which levels get logged simply by setting DEBUG_LEVEL in the Constants file.
        i. DEBUG_LEVEL_ERROR=0 - Output error message to log file with severity level ERROR. No command line print.
        ii. DEBUG_LEVEL_AUDIT=1 - Output audit message to log file with severity level INFO. No command line print.
        iii. DEBUG_LEVEL_INFO=2 - Output info message to log file with severity level INFO. No command line print.
        iv. DEBUG_LEVEL_DEBUG=3 - Output debug message to log file with severity level INFO. No command line print.
    b. The user can control the debug logging type which specifies where to write the message to. The user can set DEBUG_LOGGING_TYPE to one or more options include [LOG, DB, PRINT, EMAIL].
        i. LOG – outputs message to the DV log file cs_server.log.
        ii. DB – outputs message to the AUDIT_LOG table within the cache database that is supported.
        iii. PRINT – outputs message to the Studio command line. This is useful for manual execution and debugging.

iv. EMAIL – outputs message to an email. Must configure email in the DV Studio Administration, Configuration: /Composite Server/Configuration/E-Mail.

Cache Types

1) "FS" = Full Single table cache
2) "FM" = Full Multi-table cache
3) "IN" = Incremental cache (no staging)
4) Hybrid (staging + incremental)
    a. "HS" = Hybrid with Staging for Initial and Delta (same script)
        i. HS = **H**ybrid Delta **S**tage
    b. "HN" = Hybrid with Staging for Initial and NO staging for Delta (different scripts)
        i. HN = **H**ybrid Delta **N**o-Stage
    c. "MT1" = Merge Type 1 (Staging for initial script and staging for delta script)
        i. MT1=**M**erge **T**ype **1** See Merge Type 1 Example
    d. "MT2" = Merge Type 1 (Staging for initial script and staging for delta script)
        i. MT2=**M**erge **T**ype **2** See Merge Type 2 Example
    e. "MT4" = Merge Type 1 (Staging for initial script and staging for delta script)
        i. MT4=**M**erge **T**ype **4** See Merge Type 4 Example
5) Not implemented
    a. Partition – ability to have some data cached and some data live via a UNION

Cache Features and Attributes

Distribution Columns

1) **Distribution Column** support for Netezza – supported
    a. CONFIGURE: Netezza Distribution Column Attribute
    b. **DISTRIBUTION_COLUMNS**: Column(s) that can be used to create distribution key on NZ.
        i. <attribute><name>DISTRIBUTION_COLUMNS</name> <value>NULL</value></attribute>

Multi-Table Configuration

2) **Multi-Table configuration attributes**

a. CONFIGURE: Full Multi-Table Caching Attributes:

b. **MULTI_BUCKET_MODE**: AUTO_GEN or MANUAL. Only AUTO_GEN is supported at this time.

```
<attribute><name>MULTI_BUCKET_MODE</name>
<value>AUTO_GEN</value></attribute>
```

c. **MULTI_BUCKET_TABLE_PREFIX**: Provide an explicit name or the $DEFAULT_RES_NAME is extracted dynamically from the resource being cached.

```
<attribute><name>MULTI_BUCKET_TABLE_PREFIX</name>
<value>$DEFAULT_RES_NAME</value></attribute>
```

d. **MULTI_NUM_BUCKETS**: Default is 3. The number of cache table buckets to create by appending 0, 1, 2... to the end of the bucket table prefix.

```
<attribute><name>MULTI_NUM_BUCKETS</name> <value>3</value></attribute>
```

e. **MULTI_DROP_CREATE_INDEX**: true/false to drop and create any indexes associated with the cache view. Netezza must be false. MemSql must be false if column store indexes are used.

```
<attribute><name>MULTI_DROP_CREATE_INDEX</name>
<value>true</value></attribute>
```

f. Optional Configure: Multi-table Cache Pre/Post-Refresh Cache Procedures.

g. **FULL_PRE_CALLBACK_IMPL_PROC**: [optional] Explicit path to the ***pre-refresh*** callback implementation procedure or use the variable $APPLICATION_CACHE_PROC_IMPL which defaults to the CONSTANTS variable “ApplicationCacheProcPath” which is a path to the CacheCallbackScripts folder.

```
<attribute><name>FULL_PRE_CALLBACK_IMPL_PROC</name>
<value>$APPLICATION_CACHE_PROC_IMPL</value></attribute>
```

h. **FULL_POST_CALLBACK_IMPL_PROC**: [optional] Explicit path to the ***post-refresh*** callback implementation procedure or use the variable $APPLICATION_CACHE_PROC_IMPL which defaults to the CONSTANTS variable “ApplicationCacheProcPath” which is a path to the CacheCallbackScripts folder.

```
<attribute><name>FULL_POST_CALLBACK_IMPL_PROC</name>
<value>$APPLICATION_CACHE_PROC_IMPL</value></attribute>
```

Incremental and Hybrid Configuration

3) Incremental and Hybrid Load script configuration

a. Name type – format:
   i. “HS” – Hybrid Staging
      1. VIEWNAME_CacheLoad
   ii. “HN” – Hybrid No Staging on Delta
      1. VIEWNAME_CacheInitialLoad
      2. VIEWNAME_CacheDeltaLoad
   iii. “IN” – Incremental
      1. VIEWNAME_CacheInitialLoad
      2. VIEWNAME_CacheDeltaLoad

b. CONFIGURE: Incremental Caching Attributes:

c. **INCR_KEY_NAME**: Incremental cache column name.

<attribute><name>INCR_KEY_NAME</name><value>UPD</value></attribute>

d. **INCR_KEY_TYPE**: Incremental cache column data type for the above column.

<attribute><name>INCR_KEY_TYPE</name><value>TIMESTAMP</value> </attribute>

e. **INCR_KEY_STARTING_VALUE**: Incremental cache initial default value if history needs to be loaded.

<attribute><name>INCR_KEY_STARTING_VALUE</name><value>1900-01-01 00:00:00</value></attribute>

f. **INCR_INITIAL_LOAD_SCRIPT**: [optional] Explicit path to the incremental cache initialization refresh procedure or use the variable $APPLICATION_CACHE_INCR_SCRIPTS which defaults to the CONSTANTS variable “ApplicationIncrScriptsPath” which is a path to the CacheLoadScripts folder.

<attribute><name>INCR_INITIAL_LOAD_SCRIPT</name>
<value>$APPLICATION_CACHE_INCR_SCRIPTS</value></attribute>

g. **INCR_DELTA_LOAD_SCRIPT**: [optional] Explicit path to the incremental cache delta refresh procedure or use the variable

$APPLICATION_CACHE_INCR_SCRIPTS which defaults to the CONSTANTS variable “ApplicationIncrScriptsPath” which is a path to the CacheLoadScripts folder.

<attribute><name>INCR_DELTA_LOAD_SCRIPT</name>
<value>$APPLICATION_CACHE_INCR_SCRIPTS</value></attribute>

Incremental Merge Configuration

4) **Merge configuration attributes**

a. Name type – format:

i. “MT1” – Merge Type 1

1. VIEWNAME_CacheInitialLoad
2. VIEWNAME_CacheDeltaLoad

ii. “MT2” – Merge Type 2

1. VIEWNAME_CacheInitialLoad
2. VIEWNAME_CacheDeltaLoad

iii. “MT4” – Merge Type 4

1. VIEWNAME_CacheInitialLoad
2. VIEWNAME_CacheDeltaLoad

b. CONFIGURE: Incremental Merge Caching Attributes:

c. **INCR_MERGE_CACHE_VIEW_PKCSV**: Incremental Merge - This is a comma separated list of the names of the "primary key" of the cache view.

<attribute><name>INCR_MERGE_CACHE_VIEW_PKCSV</name>
<value>K1,K2</value></attribute>

d. **INCR_MERGE_HISTORY_TABLE_PATH**: Incremental Merge Type 1, 2, 4 - The DV path to the table/view containing history information about rows that were inserted, updated or deleted from the source table.

<attribute><name>INCR_MERGE_HISTORY_TABLE_PATH</name>
<value>/shared/.../TEST_INCR_HIST</value></attribute>

e. **INCR_MERGE_HISTORY_TABLE_PKCSV**: Incremental Merge Type 1, 2, 4 - This is a comma separated list of the names of the “primary keys” of the history table. These columns need to match 1 for 1 in order with the key values in the Cache view. NOTE: If the history table has other columns in its primary key (such as deleted date) LEAVE THEM OUT.

<attribute><name>INCR_MERGE_HISTORY_TABLE_PKCSV</name>
<value>K1,K2</value></attribute>

f. **INCR_MERGE_HISTORY_TABLE_DELDT_COL**: Incremental Merge Type 1 - The column in the history table that indicates when the row was deleted. Similar to a “last updated” column.

<attribute><name>INCR_MERGE_HISTORY_TABLE_DELDT_COL</name>
<value>SDT</value></attribute>

g. **INCR_MERGE_HISTORY_TABLE_STARTDT_COL**: Incremental Merge Type 2 - The column in the history table that indicates the bi-temporal start date.

<attribute><name>INCR_MERGE_HISTORY_TABLE_STARTDT_COL</name>
<value>SDT</value></attribute>

h. **INCR_MERGE_HISTORY_TABLE_ENDDT_COL**: Incremental Merge Type 2 - The column in the history table that indicates the bi-temporal end date.

<attribute><name>INCR_MERGE_HISTORY_TABLE_ENDDT_COL</name>
<value>EDT</value></attribute>

i. **INCR_MERGE_HISTORY_TABLE_ACTIVITYDT_COL**: Incremental Merge Type 4- The column in the history table that indicates change data capture style activity date column.

<attribute><name>INCR_MERGE_HISTORY_TABLE_ACTIVITYDT_COL</name>
<value>SDT</value></attribute>

j. **INCR_MERGE_HISTORY_TABLE_ACTIVITY_COL**: Incremental Merge Type 4- The column in the history table that indicates change data capture style activity. e.g. ACTIVITY=[I|U|D].

<attribute><name>INCR_MERGE_HISTORY_TABLE_ACTIVITY_COL</name>
<value>ACTIVITY</value></attribute>

k. **INCR_MERGE_HISTORY_TABLE_ACTIVITY_INS_VAL**: Incremental Merge Type 4- The column in the history table that indicates change data capture style activity insert value. e.g. ACTIVITY=I.

<attribute><name>INCR_MERGE_HISTORY_TABLE_ACTIVITY_INS_VAL</name>
<value>I</value></attribute>

l. **INCR_MERGE_HISTORY_TABLE_ACTIVITY_UPD_VAL**: Incremental Merge Type 4- The column in the history table that indicates change data capture style activity update value. e.g. ACTIVITY=U.

<attribute><name>INCR_MERGE_HISTORY_TABLE_ACTIVITY_UPD_VAL</name>
<value>U</value></attribute>

m. **INCR_MERGE_HISTORY_TABLE_ACTIVITY_DEL_VAL**: Incremental Merge Type 4- The column in the history table that indicates change data capture style activity delete value. e.g. ACTIVITY=D.

<attribute><name>INCR_MERGE_HISTORY_TABLE_ACTIVITY_DEL_VAL</name>
<value>D</value></attribute>

Full Cache Pre/Post Procedure Configuration

5) **Full Cache Pre/Post cache procedure configuration**

a. Supported for Full and Multi-table

b. Name format:

iv. VIEWNAME_preCallback – developer modifies this procedure

v. VIEWNAME_postCallback – developer modifies this procedure

c. Implementation procedure variables passed in:

i. constantsPath

ii. cacheViewPath

iii. cacheViewName

iv. cacheKey

d. Optional Configure: Full Cache Pre/Post-Refresh Cache Procedures:

e. **FULL_PRE_CALLBACK_IMPL_PROC**: [optional] Explicit path to the ***pre-refresh*** callback implementation procedure or use the variable $APPLICATION_CACHE_PROC_IMPL which defaults to the CONSTANTS variable “ApplicationCacheProcPath” which is a path to the CacheCallbackScripts folder.

<attribute><name>FULL_PRE_CALLBACK_IMPL_PROC</name>
<value>$APPLICATION_CACHE_PROC_IMPL</value></attribute>

f. **FULL_POST_CALLBACK_IMPL_PROC**: [optional] Explicit path to the ***post-refresh*** callback implementation procedure or use the variable $APPLICATION_CACHE_PROC_IMPL which defaults to the CONSTANTS variable “ApplicationCacheProcPath” which is a path to the CacheCallbackScripts folder.

<attribute><name>FULL_POST_CALLBACK_IMPL_PROC</name>
<value>$APPLICATION_CACHE_PROC_IMPL</value></attribute>

Drop/Create Indexes

6) **Drop/Create indexes**

a. Indexes integrated into View “Indexes” tab. If present, indexes are created otherwise no action.

b. Cache table index name format:

    i. Option 1: UPPER(VIEW_NAME)_<actual_idx_name>

    ii. Option 2: INDEX_PREFIX<actual_idx_name>

        1. This uses the INDEX_PREFIX attribute to override the default upper view name with underscore format.

c. CONFIGURE: Index Attributes

d. **INDEX_PREFIX**: Index prefix overrides the use of the upper case cached view name for prefixing the index name found on the index tab of the cached view.

    <attribute><name>INDEX_PREFIX</name><value>IDX_</value></attribute>

e. **INDEX_TYPE**: Index type is appended after the indexNameURL in the CREATE INDEX syntax and is database specific. Syntax: CREATE INDEX <indexNameURL> [INDEX_TYPE] ON <tableURL>(<columnList>) [INDEX_OPTIONS]

    <attribute><name>INDEX_TYPE</name><value></value></attribute>

f. **INDEX_OPTIONS**: Index options are appended to the end of the CREATE INDEX syntax and are database specific. Syntax: CREATE INDEX <indexNameURL> [INDEX_TYPE] ON <tableURL>(<columnList>) [INDEX_OPTIONS]

    <attribute><name>INDEX_OPTIONS</name><value></value></attribute>

g. For multi-table if the “Drop indexes before load and create indexes after refresh load” box is checked then drop and recreate is done by DV otherwise skipped.

    i. The attributes REFRESH_DROP_INDEX and REFRESH_CREATE_INDEX are ignored.

h. The attribute **REFRESH_DROP_INDEX** controls whether the indexes should be dropped during refresh. . If not specified no action is taken on indexes during refresh.

    i. The value “ALL” specifies to drop all indexes that are configured in the view. Otherwise, a comma separate list of index names may be provided.

ii. **REFRESH_DROP_INDEX**: Drop all indexes for the cache table. [ALL, <comma separated list of indexes>]

<attribute><name>REFRESH_DROP_INDEX</name>
<value>ALL</value></attribute>

i. The attribute **REFRESH_CREATE_INDEX** controls whether the indexes should be created during refresh. If not specified no action is taken on indexes during refresh.

i. The value “ALL” specifies to create all indexes that are configured in the view. Otherwise, a comma separate list of index names may be provided.

ii. **REFRESH_CREATE_INDEX**: Create all indexes for the cache table. [ALL, <comma separated list of indexes>]

<attribute><name>REFRESH_CREATE_INDEX</name>
<value>ALL</value></attribute>

Execute Table Statistics

7) Execute table statistics

a. The attribute **EXECUTE_STATISTICS** controls whether to update statistics or not after the refresh cache is complete.

i. The value “TABLE” and performs an update statistics on the table.

ii. The value “EXPRESS” is for Netezza only and performs a “generate express statistics” on the table.

b. Note: For Oracle, executing statistics on the table requires a lock on the table.

Create Cache Schedule

8) Create Cache Schedule

a. Create cache schedule using period within the cached view. This is the “Caching” tab on the view.

b. REFRESH: Schedule Attributes

c. **REFRESH_MODE**: Schedule refresh mode [MANUAL, SCHEDULED]

<attribute><name>REFRESH_MODE</name> <value>SCHEDULED</value></attribute>

d. **SCHEDULE_MODE**: When refresh mode=SCHEDULED then [CALENDAR]

<attribute><name>SCHEDULE_MODE</name> <value>CALENDAR</value></attribute>

e. **SCHEDULE_START_TIME**: When refresh mode=SCHEDULED then a valid timestamp.

<attribute><name>SCHEDULE_START_TIME</name><value>2014-06-25 00:00:00</value></attribute>

f. **SCHEDULE_PERIOD**: When refresh mode=SCHEDULED then values: SECOND, MINUTE, HOUR, DAY, WEEK, MONTH, or YEAR.

<attribute><name>SCHEDULE_PERIOD</name> <value>HOUR</value></attribute>

g. **SCHEDULE_COUNT**: When refresh mode=SCHEDULED then the number of Period units in the interval between cache refreshes. Values: Any positive integer.

<attribute><name>SCHEDULE_COUNT</name><value>1</value></attribute>

h. **EXPERIATION_PERIOD**: The amount of time in milliseconds that the cache will be cleared after it is refreshed. Values: If less than zero, the period will be set to zero. If zero then the cache will never expire. If set to NULL, the enable setting will be left unaltered.

<attribute><name>EXPERIATION_PERIOD</name> <value>1</value></attribute>

i. **CLEAR_RULE**: Indicates when old cache data should be cleared. Values: One of "NONE", "ON_LOAD", or "ON_FAILURE". Normally old cache data is cleared on expiration and when a cache refresh successfully completes. In the latter case the old cache data is replaced by the new cached data. If "NONE", then the normal behavior will be used. If "ON_LOAD", in addition to the normal behavior the old cache data will be cleared when a refresh is started. If "ON_FAILURE", in addition to the normal behavior the old cache data will be cleared when a refresh fails. If set to NULL, the setting will be left unaltered.

<attribute><name>CLEAR_RULE</name><value>NONE</value></attribute>

Create Cache Trigger Schedule

1) Create Cache Trigger Schedule

a. The cache trigger schedule provides the added advantage over the integrated cache schedule in that it provides the granularity of “Day of Week” in the schedule.

b. REFRESH: Cache Trigger Schedule Attributes

c. **TRIGGER_START_TIME**: When refresh mode=TRIGGER then a valid timestamp.

<attribute><name>TRIGGER_START_TIME</name><value>2014-06-25 00:00:00</value></attribute>

d. **TRIGGER_PERIOD**: When refresh mode=TRIGGER then values: MINUTE, HOUR, DAY, WEEK, MONTH, or YEAR.

<attribute><name>TRIGGER_PERIOD</name> <value>DAY</value></attribute>

e. **TRIGGER_COUNT**: When refresh mode=TRIGGER then the number of Period units in the interval between cache refreshes. Values: Any positive integer.

<attribute><name>TRIGGER_COUNT</name><value>1</value></attribute>

f. **TRIGGER_RECURRING_DAY**: When refresh mode=TRIGGER then NULL or a list of one or more items: [SUN, MON, TUE, WED, THU, FRI, SAT]. May be space or comma delimited.

<attribute><name>TRIGGER_RECURRING_DAY</name><value>MON WED FRI</value></attribute>

g. **TRIGGER_FROM_TIME_IN_A_DAY**: When refresh mode=TRIGGER then NULL or the time of day to start the trigger between 00:00:00 and 23:30 in 30 min increments. Format = HH24:MM:SS.

<attribute><name>TRIGGER_FROM_TIME_IN_A_DAY</name> <value>06:00:00</value></attribute>

h. **TRIGGER_END_TIME_IN_A_DAY**: When refresh mode=TRIGGER then NULL or the time of day to end the trigger between 00:00:00 and 23:30 in 30 min increments. Format = HH24:MM:SS.

<attribute><name>TRIGGER_END_TIME_IN_A_DAY</name> <value>23:59:00</value></attribute>

i. **TRIGGER_IS_CLUSTER**: When refresh mode=TRIGGER then NULL or 0=not once per cluster, 1=only once per cluster.

<attribute><name>TRIGGER_IS_CLUSTER</name> <value>1</value></attribute>

j. **TRIGGER_ANNOTATION**: When refresh mode=TRIGGER then NULL or an annotation for the trigger.

<attribute><name>TRIGGER_ANNOTATION</name> <value>annotation</value></attribute>

Rolling Purge Window

2) Rolling Purge window

a. Rolling Window - Data that rolls out of the window is purged

b. Purge Trigger Schedule Attributes

c. **PURGE_WINDOW_PERIOD**: defines the purge window that gets passed into the PurgeCacheData() procedure. (delete all rows WHERE PURGE_COLUMN_NAME <= CURRENT_TIMESTAMP - (PURGE_WINDOW_COUNT * PURGE_WINDOW_PERIOD)) values: MINUTE, HOUR, DAY, WEEK, MONTH, or YEAR.

<attribute><name>PURGE_WINDOW_PERIOD</name> <value>WEEK</value></attribute>

d. **PURGE_WINDOW_COUNT**: the number of period units in for the purge window and the value passed into PurgeCacheData() procedure. Values: Any positive integer.

<attribute><name>PURGE_WINDOW_COUNT</name> <value>1</value></attribute>

e. **PURGE_START_TIME**: a valid starting timestamp.

<attribute><name>PURGE_START_TIME</name> <value>2014-06-25 00:00:00</value></attribute>

f. **PURGE_COLUMN_NAME**: the timestamp column used for purging rows.

<attribute><name>PURGE_COLUMN_NAME</name> <value>SDT</value></attribute>

g. **PURGE_PERIOD**: defines the trigger interval period between purges. (how often the trigger fires) values: MINUTE, HOUR, DAY, WEEK, MONTH, or YEAR.

<attribute><name>PURGE_PERIOD</name><value>DAY</value></attribute>

h. **PURGE_COUNT**: the number of Period units in the interval between purges. Values: Any positive integer.

<attribute><name>PURGE_COUNT</name><value>1</value></attribute>

i. **PURGE_RECURRING_DAY**: NULL or a list of one or more items: [SUN, MON, TUE, WED, THU, FRI, SAT]. May be space or comma delimited.

<attribute><name>PURGE_RECURRING_DAY</name> <value>MON WED FRI</value></attribute>

j. **PURGE_FROM_TIME_IN_A_DAY**: NULL or The time of day to start the TRIGGER: between 00:00:00 and 23:30 in 30 min increments. Format = HH24:MM:SS

<attribute><name>PURGE_FROM_TIME_IN_A_DAY</name> <value>06:00:00</value></attribute>

k. **PURGE_END_TIME_IN_A_DAY**: NULL or The time of day to end the TRIGGER: between 00:00:00 and 23:30 in 30 min increments. Format = HH24:MM:SS

<attribute><name>PURGE_END_TIME_IN_A_DAY</name> <value>23:59:00</value></attribute>

l. **PURGE_IS_CLUSTER**: NULL or 0=not once per cluster, 1=only once per cluster

<attribute><name>PURGE_IS_CLUSTER</name> <value>1</value></attribute>

m. **PURGE_ANNOTATION**: NULL or an annotation for the trigger.

<attribute><name>PURGE_ANNOTATION</name> <value>annotation</value></attribute>

Reset Maintenance Level

3) Reset maintenance level to force a full refresh

a. Reset the maintenance level back to null and reload the DV cache with the maintenance level.

Validation

4) Validation

a. Validate database table and index name length for max allowed

b. Alleviate naming collisions. Validate the cache or staging view is a dependent of the target DB cache or staging table to ensure that the table

will not be dropped/created by mistake if the table name actually belongs to a different DV resource.

Ability to Initialize Framework

1) Rebind packaged queries after installation using the RebindPackagedQueries script.
2) Manage [drop/create] audit log correlation database sequence id CACHE_FRAMEWORK_SEQ
    a. CreateDBSequence
    b. DropDBSequence
3) Manage [drop/create] AUDIT_LOG_SEQ_table
    a. Create_AUDIT_LOG_SEQ
    b. Drop_AUDIT_LOG_SEQ
4) Manage [drop/create] AUDIT_LOG table
    a. Create_AUDIT_LOG
    b. Drop_AUDIT_LOG
5) Manage [drop/create] CACHING_DATA table
    a. Create_CACHING_DATA
    b. Drop_CACHING_DATA
    c. Insert_CACHING_DATA

Ability to De-configure a Cache

The Cache Framework provides the ability to de-configure the cache resource in two different ways:

1. De-configure a single cache resource by providing the path.
2. De-configure all caches in CACHING_DATA by leaving path null.

The following provides a detailed background on what the de-configure operation will execute:

1) Disable primary cache view (disable cache)
2) If Staging table used
    a. Destroy staging view
    b. Destroy DV staging table
    c. Drop staging table in database
    d. Delete the staging table cache_status row

3) Destroy DV cache load or callback scripts. Optional to destroy custom callback implementation scripts.
    a. Destroy first call back script [Initial Load or Pre-Callback and Pre-Callback Implementation (optional)]
    b. Destroy second call back script [Initial Load or Pre-Callback and Pre-Callback Implementation (optional)]
4) Destroy DV cache table
5) Drop cache tables in database
6) De-configure primary cache view
    a. Destroy cache configuration
    b. Delete the cache table cache_status row
7) Destroy the cache refresh trigger if it exists
8) Destroy the cache purge trigger if it exists
9) Delete AUDIT_LOG_SEQ entry
10) Verify the De-configuration

6 Cache Framework Deployment

The following is a discussion of how deployment works with the Cache Framework.

Overview of Deployment

This discussion puts the deployment of cache objects into perspective of the bigger picture. When deploying cache objects, the developer must consider several factors.

1. The type of cache object [full or increment] being deployed.
    a. When a full cache object is being deployed, there are no issues with deploying an object even if that object has been deployed before. If something happens to the cache_status for that cache, it will be marked as invalid and will be fully refreshed on the next access to that cache object.
    b. When an incremental cache object is being deployed for the first time there are no issues as the first time there is no data in the target cache. However, care must be taken not to deploy an incremental object again as it may result in marking the cache_status to invalid thus causing a complete refresh of that cache.
2. How the DV objects get instantiated in the target server.
    a. Packaged Import scripts is one methodology.
    b. If running DV 7.0 or higher, Deployment Manager is another methodology.
    c. AS Assets PDTool is another methodology.
3. Methodology importing objects. This can be done via package import or version control deployment using PDTool.
    a. Ideally, all objects listed below would be packaged together into a single .car file for import unless PDTool version control is being used in which case, the deployment plan should list the resources in the order shown below:
        i. “CachingData” procedure will be used to setup the Cache Framework metadata. It is the only mechanism that is used to pass the intelligence about what is cached to the target server.
        ii. Associated DV cache procedures scripts.
        iii. Associate DV cache triggers.
        iv. Associated DV staging views.
        v. Actual DV view that is the primary cache target view.

4. How the database objects get created in the target cache database server.
    a. The DeployCache procedure gets execute after import of the resources which creates any necessary tables and introspects them into DV.
5. How the cache refresh is performed.
    a. The Cache Framework RefreshCache procedure can be executed from Studio or externally by a JDBC/ODBC tool.

How to Deploy Cache Objects

How deployment works.

DeployCache Procedure

This procedure is the main driver script for deploying cache views and tables. The script has the following input:

inResourcePath - VARCHAR(4096), - The specific view path to be configured or leave null to configure all views in CachingData (procedure) / CACHING_DATA (table).

- This path acts as a filter for what is already configured in CACHING_DATA so the view must have already been configured in CACHING_DATA.
- Use a wildcard "%" at the end of the path to signify any text matching the text preceding the wildcard symbol "%".
- If a container path is passed in with no wildcard "%", then the wildcard will be added automatically so that only view paths within this path range are deployed if applicable.

The script performs the following:

1. Execute the CachingData_Insert procedure to insert CachingData() rows into CACHING_DATA table.
    a. The assumption is that with the deployment of a new table, the CACHING_DATA metadata has not been inserted into the table and must be done prior to executing any cache configuration operations.
    b. Note: It is required to deploy the CachingData procedure each time there is a cached view deployed.
2. Determine if the cache needs to be deployed based on whether cache tables exist in TDV and the generated view DDL columns and types matches the cache table columns and types excluding the cachekey column if it exists. If the this is a pre-existing cached view and the tables exist and they match the view signature then no action is taken.
3. If deploy cache then perform the following
    a. Disable the cache views according to CACHING_DATA query.
    b. Invoke ConfigureCacheScript to create the tables but don't configure the views.

i. The following dynamic SQL is used to override the "DROP_RECREATE_VIEW_YN" by defaulting it to "N" so that the views do not get configured at the time of deployment no matter how that flag is set within the "CACHING_DATA" procedure. Also note that the actual table path is substituted for the variable $CachingDataTablePath at the time of deployment. Finally, the value of "DROP_RECREATE_TABLE_YN" is read from the CACHING_DATA table as per how it was set in the "CachingData" procedure. If it is set to "N" then no tables are created in the target cache database.

```
SELECT {option DISABLE_PLAN_CACHE, NO_DATA_CACHE}
   RUN_YN,
   "N" DROP_RECREATE_VIEW_YN,
   DROP_RECREATE_TABLE_YN,
   CACHE_TYPE,
   RESOURCE_PATH,
   ORGANIZATION,
   APPLICATION_NAME,
   CONSTANTS_PATH,
   CAST(ATTRIBUTES AS LONGVARCHAR) ATTRIBUTES
FROM $CachingDataTablePath
```

c. Update impacted resources.

d. Enable the cache views according to CACHING_DATA query.

The script has the following output:

errStatus	VARCHAR,	-- Status=SUCCESS, WARNING or FAIL
errMessage	LONGVARCHAR,	-- Status message upon FAIL otherwise NULL
warningMessage	LONGVARCHAR,	-- Warning messages.
numTablesCreated	INTEGER,	-- The number of tables created by executing the DDL.
tableCreatedList	LONGVARCHAR,	-- Comma separated list of database tables created by executing the DDL or NULL if none.
numViewsDeployed	INTEGER,	-- The number of views that were deployed or NULL if none.
viewsDeployedList	LONGVARCHAR,	-- Comma separated list of views that were deployed or NULL if none.
numViewsConforming	INTEGER,	-- The number of views that were not deployed because they are conforming to the existing table structure and do not need to be deployed.

viewsConformingList LONGVARCHAR -- Comma separated list of views that are conforming to the table structure and don't need to be deployed.

Sample PDTool Deployment Plan

This is a sample deployment plan which shows the order in which resources are checked out from VCS and imported into the target server. It also shows how to invoke the DeployCache procedure.

```
# ----------------------------------------
# VCS Module: Cache Configuration Objects
# ----------------------------------------
PASS TRUE ExecuteAction vcsCheckout2 $SERVERID $VCONN
/shared/ASAssets/CacheManagement/CacheFrameworkSample/Oracle_Application/DataScripts/CachingData
"PROCEDURE" HEAD "$MODULE_HOME/VCSModule.xml" "$MODULE_HOME/servers.xml"

# ----------------------------------------
# VCS Module: DV Database Objects
# ----------------------------------------
PASS TRUE ExecuteAction vcsCheckout2 $SERVERID $VCONN
/shared/ASAssets/CacheManagement/CacheFrameworkSample/Oracle_SampleSOR/SOR/SAMPLE_DS/CIS_CACHE/
V_Test_Datatypes_MixedCase "TABLE" HEAD "$MODULE_HOME/VCSModule.xml"
"$MODULE_HOME/servers.xml"
PASS TRUE ExecuteAction vcsCheckout2 $SERVERID $VCONN
/shared/ASAssets/CacheManagement/CacheFrameworkSample/Oracle_SampleSOR/SOR/SAMPLE_DS/CIS_CACHE/
V_Test_Datatypes_MixedCase_STG "TABLE" HEAD "$MODULE_HOME/VCSModule.xml"
"$MODULE_HOME/servers.xml"

# ----------------------------------------
# VCS Module: DV Procedure Script Objects
# ----------------------------------------
PASS TRUE ExecuteAction vcsCheckout2 $SERVERID $VCONN
/shared/ASAssets/CacheManagement/CacheFrameworkSample/Oracle_SampleViews/Scripts/CacheLoadScripts/V_Te
st_Datatypes_MixedCase_CacheDeltaLoad "PROCEDURE" HEAD "$MODULE_HOME/VCSModule.xml"
"$MODULE_HOME/servers.xml"
PASS TRUE ExecuteAction vcsCheckout2 $SERVERID $VCONN
/shared/ASAssets/CacheManagement/CacheFrameworkSample/Oracle_SampleViews/Scripts/CacheLoadScripts/V_Te
st_Datatypes_MixedCase_CacheInitialLoad "PROCEDURE" HEAD "$MODULE_HOME/VCSModule.xml"
"$MODULE_HOME/servers.xml"

# ----------------------------------------
# VCS Module: DV Staging Objects
# ----------------------------------------
PASS TRUE ExecuteAction vcsCheckout2 $SERVERID $VCONN
/shared/ASAssets/CacheManagement/CacheFrameworkSample/Oracle_SampleViews/Scripts/CacheStagingViews/V_
Test_Datatypes_MixedCase_STG "TABLE" HEAD "$MODULE_HOME/VCSModule.xml"
"$MODULE_HOME/servers.xml"
```

 # VCS Module: DV Primary Cache View

PASS TRUE ExecuteAction vcsCheckout2 $SERVERID $VCONN /shared/ASAssets/CacheManagement/CacheFrameworkSample/Oracle_SampleViews/Views/**V_Test_Datatypes_MixedCase** "TABLE" HEAD "$MODULE_HOME/VCSModule.xml" "$MODULE_HOME/servers.xml"

 # Resource Module: Deploy Cache Database Objects

- PASS TRUE ExecuteAction executeProcedure $SERVERID **CacheManagement.CacheFramework.DeployCache ASAssets** "$MODULE_HOME/servers.xml" "'0','0', '/shared/ASAssets/CacheManagement/CacheFrameworkSample/Oracle_Application/Constants/Constants', '/shared/ASAssets/CacheManagement/CacheFrameworkSample/Oracle_SampleViews/Views/V_Test_Datatypes_MixedCase'" true

7 Cache Framework Implementation

The following is a discussion of how the Cache Framework has been implemented.

Full Caching Methodology

At its most basic, the full caching solution involves the following steps:

- Gather all the current rows from the system of record.
- Insert the gathered rows into the cache table.
- If native load is available for the cache target and configured in DV then use it otherwise use JDBC inserts.

Incremental Caching Methodology

At its most basic, the incremental caching solution involves the following steps:

- This only handles new record inserts since the last refresh.
- Gather the current rows that have been inserted since the last full or incremental refresh.
- Insert the gathered rows into the cache table.

Hybrid Incremental Caching Methodology

At its most basic, the hybrid incremental caching solution involves the following steps:

- This only handles new record inserts since the last refresh.
- For first time, initial load performs a native load (if configured) into a staging table and once complete, perform a local database insert/select from staging into the cache table.
- For delta loads, gather the current rows that have been inserted since the last full or incremental refresh.
- Insert the gathered rows into the cache table.

Hybrid Incremental Merge Caching Methodology

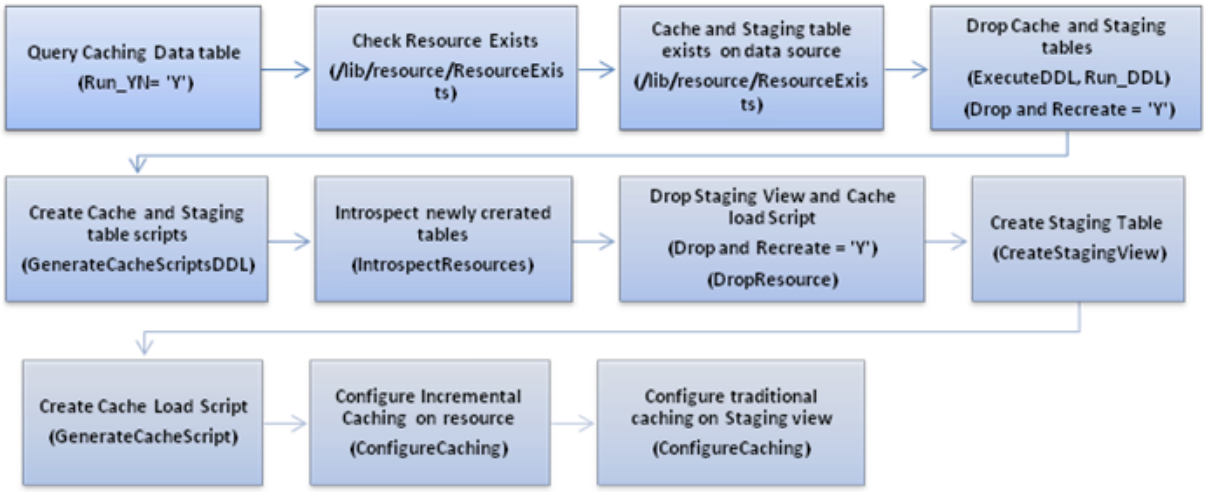
At its most basic, the incremental merge caching solution involves the following steps:

- This only handles inserts, updates and deletes since the last refresh.
- For first time, initial load perform a native load (if configured) into a staging table and once complete, perform a local database insert/select from staging into the cache table.

- For delta loads, gather the rows that have been inserted, updated, and deleted since the last full or incremental refresh.
- Insert the gathered rows into a staging table.
- Apply the changed rows to the existing cache data using the caching database's native `MERGE` command. This executes as a single ACID compliant transaction.

Scripts

This folder contains the generic scripts that get invoked by the application template scripts.
The chart below details what the main script <CF_FOLDER>/Scripts/ConfigureCacheScript does when it performs a cache configuration:



The target data source for caching should be pre-configured for caching. This means that cache status and cache tracking table must be created and introspected. For best results, the case sensitivity and trailing space setting should match the settings of the view that is cached.
For each of the views that need to be cached, the “ConfigureCache” script iterates through the list and performs following steps:

1. Check if the target data source is configured for caching
2. Call /lib/resource/ResourceExists API and check if the view exists.
3. If drop and recreate database tables is Y (DROP_RECREATE_TABLE_YN=Y)
    a. Call GetResource API function with view name as parameter to get columns and data type information and create a DDL string for creating a cache table.
    b. When cache type is incremental, calls GetResource API function with view name as parameter to get columns and data type information and create a DDL string for creating a staging table.
    c. Drop caching tables on data source

   d. Drop staging table on the data source if cache type is Hybrid incremental (HS, HN, HM).
   e. Create the cache table by executing the DDL statement created in step 3a.
   f. For incremental caching, create a staging table creating by executing the DDL statement generated in step 3b.
   g. Introspect the data source to bring in the cache and staging target table.
4. If drop and recreate DV resources is Y (DROP_RECREATE_VIEW_YN=Y)
   a. Drop Staging view resource if drop resources flag is set to Y
   b. Create a staging view as copy of source view in predefined folder when Hybrid incremental (HS, HN, HM, MT1, MT2, MT4).
   c. Drop caching scripts if exist
   d. Generate caching scripts
   e. Configure caching parameters for the view. This step updates the following on the view
      i. Target database
      ii. Target table
      iii. Refresh schedule configure as per attributes
      iv. Update incremental scripts
   f. Configure caching parameters for staging view using default caching mechanism and update the following information
      i. Target database
      ii. Target table for staging view cache
      iii. Manual refresh schedule

NOTE: The caching framework described in above section only configures a resource for caching. The framework does not start a refresh of data.

Cache Framework Application Template Folder

This folder contains the “interface” scripts used to initialize, manage, configure or deconfigure caching for a view. The following sections describe the sub-folders of `<CF_Folder>`/ApplicationTemplate[Oracle|SqlServer|Netezza|MemSql|Postgres]. This folder will be referred to as “**ApplicationTemplate**”.

Constants Folder

ApplicationTemplate/Constants/Constants()

This procedure contains a number of constants and other resources that are used by a number of caching resources. Update the `ApplicationBasePathConstant` variable with the correct value for `<CF_Folder>`.

DataScripts Folder

ApplicationTemplate/DataScripts/CachingData()

This procedure is used to hold data for the caching framework. This script returns a cursor output which is used by ConfigureCache to orchestrate the scripting. This procedure is the primary mechanism used when deploying a cache resource from one environment to another. This resource should always be deployed along with the cached view and any other dependent resources except the TDV cache tables which get created at the time of deployment. The data populated in this script contains the following structure and correlates one for one with the CACHING_DATA database table:

Column Name	Required	Column Description
RUN_YN	Y	Possible values are 'Y' or 'N'. Identifies rows for which caching script should be executed.
DROP_RECREATE_VIEW_YN	Y	Possible values 'Y' or 'N' If 'Y' is provided, the script will drop and recreate all DV caching framework related objects. If 'N' is provided, existing objects will not be dropped, but ignored.
DROP_RECREATE_TABLE_YN	Y	Possible values 'Y' or 'N' If 'Y' is provided, the script will drop and recreate all database caching and staging tables on the cache target data source. This value is independent of the Drop and Recreate views. If 'N' is provided, existing objects will not be dropped, but ignored.
CACHE_TYPE	Y	The type of cache to configure. FS=Full Single FM=Full Multi-table IN=Incremental HS=Hybrid with Delta Staging table HN=Hybrid with Delta No Staging Table MT1=Merge Type 1 (Oracle and SQL Server) MT2=Merge Type 2 (Oracle and SQL Server) MT4=Merge Type 4 (Oracle and SQL Server)
RESOURCE_PATH	Y	Full path of the view being cached.
ORGANIZATION	Y	Organization name is used to identify the high-level usage such as "Mortgage". It is used as a filter for AUDIT_LOG and CACHING_DATA.
APPLICATION_NAME	Y	Application name is used to identify the subject area usage. It is used as a filter for AUDIT_LOG and CACHING_DATA.

CONSTANTS_PATH	Y	The full DV path to the application constants file. This provides the context for all cache framework operations.
ATTRIBUTES	N	Provides an XML configuration of attributes to configure various features. This value can be NULL. Name/Value pair attributes.

ApplicationTemplate/DataScripts/CachingData_Display()

This procedure is used to display the contents of CACHING_DATA table within the context of this "ORGANIZATION" and "APPLICATION_NAME".

ApplicationTemplate/DataScripts/CachingData_Insert()

This script provides a way of inserting rows from the CachingData() procedure into the CACHING_DATA table. The procedure uses a delete filter on "ORGANIZATION" and "APPLICATION_NAME" when deleting records prior to insert.

Execute Folder

ApplicationTemplate/Execute/AuditLogDisplay()

This procedure is used to dynamically display rows in the AUDIT_LOG table. The input parameters are qualified by operators such as EQUAL "=" or LIKE "like". If the input parameter does not have a qualifier then it is assumed to use EQUAL "=" when constructing the where clause. If any input parameters are left NULL/blank they are not used to construct the where clause. The following are a list of input parameters that may be used:

- `SEQUENCE_NUM` – The sequence number that is used to correlate across a group of like messages.
- `RESOURCE_NAME_EQUAL` – A resource name equivalent.
- `RESOURCE_NAME_LIKE` – A resource name like using a wildcard at the end of the string.
- `NOTIFICATION_TYPE` – The notification type [ERROR, AUDIT, INFO, DEBUG].
- `ORIG_USER_NAME` – The user@domain that originated the process.

ApplicationTemplate/Execute/ConfigureCache()

This procedure is the main driver script and will do the following when configuring a cache view.

- Query CachingData driver table for all records with RUN_YN = 'Y'
- Create cache table on data source
- Create stage cache table on data source
- Introspect both tables
- Create staging view resource as a copy of primary view
- Create cache load script
- Configure cache on primary view

- Configure cache on staging view (default caching method)
- Drop and recreate cache table, staging table, cache scripts, stage view as well as trigger

The following are a list of input parameters that may be used:

- `inResourcePath` – The specific view path to be configured or leave null to configure all views in CachingData (procedure) / CACHING_DATA (table). This path acts as a filter for what is already configured in CACHING_DATA so the view must have already been configured in CACHING_DATA. Use a wildcard "%" at the end of the path to signify any text matching the text preceding the wildcard symbol "%".

ApplicationTemplate/Execute/ConfigureCache_Multi_Table()

This procedure is the main driver script and will do the following when configuring a multi-table cache view.

It is provided for “ease of use”. It automatically updates the CachingData procedure and table so that the developer does not have to manually edit the script and insert the data into the table. The default mode is to configure multi-table caching with a pre-callback and post-callback procedure integrated into the cache view. It is configured to automatically drop and create indexes on the cache table during a cache refresh.

- Automatically update the CACHING_DATA table and then regenerate the CachingData driver procedure.
- Create three cache tables in the data source.
- Introspect all necessary tables.
- Configure caching on primary view.
- Configure pre-callback and post-callback procedures.
- Drop and recreate cache table
    a. Except when MemSql column store indexes are used.
- Create indexes if configured on the target view.

The following are a list of input parameters that may be used:

- `inResourcePath` – The full path to the view to be configured for multi-table caching.
- `tableConstraints` – Table Constraint(s) that can be used to qualify the table. Null if no table constraints. Database specific syntax that succeeds the column list and within the right parenthesis. CREATE TABLE "tablename"({ColumnList}, {TableConstraints}) {TableOptions}
    a. Separators: Each column in the table constraints list must contain a valid begin and end separator.
        - Oracle, Netezza, Postgres begin=" end="
        - SqlServer begin=[end=]
        - MemSql begin=` end=`

- MemSql: Format: key(<sortkeylist>) using clustered columnstore, shard key(<shardlist>) Example: key(`K1`,`K2`) using clustered columnstore, shard key(`S1`,`S2`)

- `tableOptions` – Table option(s) that can be used to qualify how the table is created. Null if no table options. Database specific syntax that succeeds the column list and is outside the right parenthesis. CREATE TABLE "tablename"({ColumnList}, {TableConstraints}) {TableOptions}

    a. Separators: Each column in the table option list must contain a valid begin and end separator.

        - Oracle, Netezza, Postgres begin=" end="
        - SqlServer begin=[end=]
        - MemSql begin=` end=`
        - Netezza: Format: DISTRIBUTE ON (<keylist>)Example: DISTRIBUTE ON ("C1", "C2")
        - MemSql: Example: AUTOSTATS_ENABLED

MemSql_ApplicationTemplate/Execute/ConfigureCache_Multi_ColumnStore() [deprecated]

[DEPRECATED]. Use. ConfigureCache_Multi_Table to achieve the same capability.

This MemSql only procedure is the main driver script and will do the following when configuring a cache view with a MemSql columnstore.

It is provided for “ease of use”. It automatically updates the CachingData procedure and table so that the developer does not have to manually edit the script and insert the data into the table. The default mode is to configure multi-table caching with a pre-callback and post-callback procedure integrated into the cache view. It is configured to automatically drop and create indexes on the cache table during a cache refresh.

- Automatically update the CACHING_DATA table and then regenerate the CachingData driver procedure.
- Create multiple cache tables in the data source.
- Introspect all necessary tables.
- Configure caching on primary view.
- Drop and recreate cache table.

The following are a list of input parameters that may be used:

- `inResourcePath` – The full path to the view to be configured for multi-table caching.
- `keyNameList` – A comma-separated list of key names to create a column store from. Null if no column store is to be created.

ApplicationTemplate/Execute/ConfigureCacheAdhoc()

This procedure provides a way of configuring a cache view in an adhoc way bypassing the CachingData() procedure. This script performs the same functions as "ConfigureCache" and is the main driver script and will do the following:

- Query CachingData driver table for all records with RUN_YN = 'Y'
- Create caching table on data source
- Create staging cache table on data source
- Introspect both tables
- Create staging view resource as a copy of primary view
- Create cache load script
- Configure caching on primary view
- Configure caching on staging view (default caching method)
- Drop and recreate caching table, staging table, caching scripts, staging view as well as trigger

The following are a list of input parameters that may be used:

- `inResourcePath` – The specific view path to be configured or leave null to configure all views in CachingData (procedure) / CACHING_DATA (table). This path acts as a filter for what is already configured in CACHING_DATA so the view must have already been configured in CACHING_DATA. Use a wildcard "%" at the end of the path to signify any text matching the text preceding the wildcard symbol "%".
- `inCacheType` – Valid types include the list below. Only specified when inResourcePath is specified.
    - FS=Full Single table cache, Optional Pre/Post callback scripts generated when using "ConfigureCache" procedure.
    - FM=Full Multi-table cache, Optional Pre/Post callback scripts generated when using "ConfigureCache" procedure.
    - IN=Incremental cache (no staging tables), Initial Load and Delta Load scripts generated.
    - HS=Hybrid with Delta Staging table, Initial and Delta use the same load script.
    - HN=Hybrid with Delta No Staging Table, Inital Load and Delta Load scripts generated.
    - MT1=Merge Type 1 using Deleted Table. Hybrid Merge Table with Initial and Delta staging table utilized and separate Initial and Delta load script.
    - MT2=Merge Type 2 using History table with Start and End Date (Bi-temporal)
    - MT4=Merge Type 4 using CDC style where there is an activity column specifying the action [I,U,D]. Hybrid Merge Column with Initial and Delta staging table utilized and separate Initial and Delta load script.

- `inDropRecreateViewYN` – Y/N. Drop and recreate the DV view resource. Only specified when inResourcePath is specified.
- `inDropRecreateTableYN` – Y/N. Drop and recreate the database table. Only specified when inResourcePath is specified.
- `inAttributes` – XML-based attributes if needed. Leave null if no attributes. Only specified when inResourcePath is specified.

ApplicationTemplate/Execute/DeconfigureCache()

This procedure is the main driver script that will de-configure the cache. It will do the following:

1. Disable primary cache view (disable cache)
2. If Staging table used
    a. 2.a. Destroy staging view
    b. 2.b. Destroy DV staging table
    c. 2.c. Drop staging table in database
    d. 2.d. Delete the staging table cache_status row
3. Destroy DV cache load or callback scripts. Optional to destroy custom callback implementation scripts.
    a. 3.a. Destroy first call back script [Initial Load or Pre-Callback and Pre-Callback Impl (optional)]
    b. 3.b. Destroy second call back script [Initial Load or Pre-Callback and Pre-Callback Impl (optional)]
4. Destroy DV cache table
5. Drop cache tables in database
6. De-configure primary cache view
    a. 6.a. Destroy cache configuration
    b. 6.b. Delete the cache table cache_status row
7. Destroy the cache refresh trigger if it exists
8. Destroy the cache purge trigger if it exists
9. Delete AUDIT_LOG_SEQ entry
10. Verify the De-configuration

The following are a list of input parameters that may be used:

- `inResourcePath` – The specific view path to be configured or leave null to configure all views in CachingData (procedure) / CACHING_DATA (table). This path acts as a filter for what is already configured in CACHING_DATA so the view must have already been

configured in CACHING_DATA. Use a wildcard "%" at the end of the path to signify any text matching the text preceding the wildcard symbol "%".

ApplicationTemplate/Execute/DeployCache()

This procedure is the main driver script for deploying cache views and tables. The script performs the following:

1. Execute the CachingData_Insert procedure to insert CachingData() rows into CACHING_DATA table
2. Determine if the cache needs to be deployed based on whether cache tables exist in TDV and the generated view DDL columns and types matches the cache table columns and types excluding the cachekey column if it exists. If the this is a pre-existing cached view and the tables exist and they match the view signature then no action is taken.
3. If deploy cache then perform the following
    a. Disable the cache views according to CACHING_DATA query
    b. Invoke ConfigureCacheScript to create the tables but don't configure the views
    c. Update impacted resources
    d. Enable the cache views according to CACHING_DATA query

Input for DeployCache

inResourcePath VARCHAR(4096) - The specific view path to be configured or leave null to configure all views in CachingData (procedure) / CACHING_DATA (table).

- This path acts as a filter for what is already configured in CACHING_DATA so the view must have already been configured in CACHING_DATA.
- Use a wildcard "%" at the end of the path to signify any text matching the text preceding the wildcard symbol "%".
- If a container path is passed in with no wildcard "%", then the wildcard will be added automatically so that only view paths within this path range are deployed if applicable.

ApplicationTemplate/Execute/MigrateCachedViews()

This script provides a way to migrate views into the Cache Framework that are not under the control of the Cache Framework. Being under control of the Cache Framework means having a row in the CACHING_DATA table for each cached view and an equivalent row in the "CachingData" procedure.

Given a starting path, this procedure will interrogate each view and determine if it is currently in the Cache Framework or not. If not, it will add the view to the Cache Framework. Alternatively,

the user may point directly to a cached view and only bring in that one view into the Cache Framework.

After completion of this procedure, if there are views that you do not want in the Cache Framework, then remove them from the "CachingData" procedure and execute "CachingData_Insert" to remove and insert the remainder of the views in "CachingData".

Input:

startingResourcePath VARCHAR(4096), - The starting CONTAINER path to search for cached views or a specific path to a cached view to bring into the Cache Framework.

Output:

```
result                          CURSOR (
        status          VARCHAR,    -- The status of what happend with the resource path.
                                    -- MIGRATED=The view was migrated into the Cache Framework.
                                    -- BYPASS=The view already exists and was bypassed.
                                    -- FAIL=A failure occurred.
        cacheType       VARCHAR,    -- The type of cache: FS=single, FM=multi-table, IN=incremental
        resourcePath    VARCHAR(4096),-- The resource path being migrated.
        message         LONGVARCHAR,-- Any messages regarding the resource path.
        actions         LONGVARCHAR-- Any actions that must be taken post migration.
        )
```

ApplicationTemplate/Execute/PurgeCacheData()

This procedure is a generic script that is invoked by the purge data trigger to purge data within a rolling period of time. The purge time is determined by the current timestamp - the purge period and compared to a timestamp column within the data. All rows are purged (deleted) that fall outside that rolling window.

- `inSequenceName` – The name of the sequence. Leave null when called manually and a sequence will be generated otherwise it is passed in from the invoking procedure.
- `inOrigUserName` – The original user@domain who started the process and transcends sessions. If not set it will be retrieved from the environment.
- `constantsPath` – Path to the application constants procedure.
- `purgeQuantity` – The quantity for the purgePeriod.
- `purgePeriod` – One of [HOUR, DAY, WEEK, MONTH, YEAR]. Note: MONTH is 31 days.
- `purgeColumnName` – The timestamp column used to compare with the purge period.
- `cacheViewPath` – The path to the DV cache view.

ApplicationTemplate/Execute/RefreshCache()

This procedure is used to kick off a cache refresh on a resource. Currently the default resource type is set to TABLE. The script takes one parameter "resourcePath" which is the full path to the view. The script parses the view path to extract the view name. The script returns SUCCESS or FAIL as output parameter depending if the cache refresh was successful or failure. Failure reason is written to the cache framework log "cfLog" which determines the log type based on how the "Constants" are configured. The log entry may go to the cs_server.log file, Audit_log, or printed to the command line. More than one option can be selected.

This script uses a blocking strategy; therefore, the script will wait till the refresh either completes or fails. The polling time is configurable and is currently set to 30 seconds to test whether the cache is completed or not.

Initialize Folder

ApplicationTemplate/Initialize/_Execute_All_Scripts()

This procedure is an initialization script used drive the execution of all of the initialization scripts in this folder.

ApplicationTemplate/Initialize/Create_AUDIT_LOG()

This procedure is an initialization script used to create the AUDIT_LOG table. This script only needs to be run once. This script will automatically drop the AUDIT_LOG table if it exists before creating it.

ApplicationTemplate/Initialize/Create_AUDIT_LOG_SEQ()

This procedure is an initialization script used to create the AUDIT_LOG_SEQ table. This script only needs to be run once. This script will automatically drop the AUDIT_LOG_SEQ table if it exists before creating it.

ApplicationTemplate/Initialize/Create_CACHING_DATA()

This procedure is an initialization script used to create the CACHING_DATA table. This script only needs to be run once. This script will automatically drop the CACHING_DATA table if it exists before creating it.

ApplicationTemplate/Initialize/CreateDBSequence()

This procedure is an initialization script used to create the CACHE_FRAMEWORK_SEQ sequence. This script does *not* drop the sequence first. The drop sequence must be invoked separately. The CACHE_FRAMEWORK_SEQ is used to correlate a unique number across DV sessions and transactions. It is used during all operations of the cache framework including Refresh, Configuration, De-configuration and other operations. It uses the AUDIT_LOG_SEQ table to store a correlation name and sequence number. For example, if a cache refresh was started by a user which then goes through the admin interface, the user name is preserved along with the sequence number even though control was transferred to another user. Additionally, the

sequence number is preserved through the cache execution of either incremental load scripts or call back scripts.

ApplicationTemplate/Initialize/Drop_AUDIT_LOG()
This procedure is an initialization script used to drop the AUDIT_LOG table. This script also gets invoked by Create_AUDIT_LOG. This script will drop the AUDIT_LOG table if it exists before creating it.

ApplicationTemplate/Initialize/Drop_AUDIT_LOG_SEQ()
This procedure is an initialization script used to drop the AUDIT_LOG_SEQ table. This script also gets invoked by Create_AUDIT_LOG_SEQ. This script will drop the AUDIT_LOG_SEQ table if it exists before creating it.

ApplicationTemplate/Initialize/Drop_CACHING_DATA()
This procedure is an initialization script used to drop the CACHING_DATA table. This script also gets invoked by Create_CACHING_DATA. This script will drop the CACHING_DATA table if it exists before creating it.

ApplicationTemplate/Initialize/DropDBSequence()
This procedure is an initialization script used to drop the CACHE_FRAMEWORK_SEQ sequence.

ApplicationTemplate/Initialize/RebindPackagedQueries()
This procedure is an initialization script used to rebind the packaged queries from the temporary datasource to the one specified in the Constants procedure.

PackagedQueryDDLScripts Folder

ApplicationTemplate/PackagedQueryDDLScript/TEMP_DS
This is the temporary data source used only at installation time when a rebind of the packaged queries is performed from the temp data source to the actual data source which is configured in the “constants” procedures.

ApplicationTemplate/PackagedQueryDDLScript/ExecuteDDL()
This is a packaged query that is used to execute any DDL on the cache data source. It is rebound to the actual data source at the time of application configuration using the “/Initialize/RebindPackagedQueries” procedure.

The following are a list of input parameters that may be used:

- `inputSQL` – Take a SQL statement.

ApplicationTemplate/PackagedQueryDDLScript/GetIntResult()
This is a packaged query that is used to execute any DML query that returns an integer value on the cache data source. For example SELECT COUNT(*) FROM x. It is rebound to the actual data source at the time of application configuration using the “/Initialize/RebindPackagedQueries” procedure.

The following are a list of input parameters that may be used:

- `selectCountSQLStatement` – Take a Select Count(*) SQL statement.

MemSql_ApplicationTemplate/PackagedQueryDDLScript/ShowIndexes()
This is a packaged query that is used by MemSql only to get/show indexes on a table.

MemSql_ApplicationTemplate/PackagedQueryDDLScript/ShowTables()
This is a packaged query that is used by MemSql only to get/show tables in a schema.

Published Procedures

The published procedures are those that can be invoked externally by a 3rd party JDBC or ODBC tool.

/databases/ASAssets/CacheManagement/CacheFramework/ClearPlanCache()
This procedure is designed to clear the plan cache. This script uses the admin interface providing elevated privileges to perform this action.

/databases/ASAssets/CacheManagement/CacheFramework/ClearRepositoryCache()
This procedure is designed to clear the repository cache. This script uses the admin interface providing elevated privileges to perform this action.

/databases/ASAssets/CacheManagement/CacheFramework/ConfigureCache()
This procedure uses the admin interface providing elevated privileges to perform this action. Refer back to ApplicationTemplate/Execute/ConfigureCache for more details.

/databases/ASAssets/CacheManagement/CacheFramework/ConfigureCache_Multi_Table()
This procedure uses the admin interface providing elevated privileges to perform this action. Refer back to ApplicationTemplate/Execute/ConfigureCache_Multi_Table for more details.

/databases/ASAssets/CacheManagement/CacheFramework/ConfigureCacheAdhoc()
This procedure provides a way of configuring a cache view in an adhoc way bypassing the CachingData() procedure. This script uses the admin interface providing elevated privileges to perform this action. Refer back to ApplicationTemplate/Execute/ConfigureCacheAdhoc for more details.

/databases/ASAssets/CacheManagement/CacheFramework/CopyPrivilegesFromParent()
This procedure is designed to push privileges to a newly create resource and makes is same as the parent folder in which the resource exists. This script uses the admin interface providing elevated privileges to perform this action.

The script takes a resource name with path and resource type as input parameter and returns SUCCESS or FAIL as output message. Additional logging is done in AUDIT_LOG table as well as in cs_server.log file. This script requires the user executing the script to have GRANT privileges on the source folder.

/databases/ASAssets/CacheManagement/CacheFramework/DeconfigureCache()
This procedure is used to de-configure the cache. Refer back to ApplicationTemplate/Execute/DeconfigureCache for more details.

/databases/ASAssets/CacheManagement/CacheFramework/IntrospectTables()
This procedure is used to provide a consistent and generic interface for introspecting database tables. This script uses the admin interface providing elevated privileges to perform this action.

/databases/ASAssets/CacheManagement/CacheFramework/RefreshCache()
This procedure is used to kick off a cache refresh on a resource. Currently the default resource type is set to TABLE. This script uses the admin interface providing elevated privileges to perform this action. Refer back to ApplicationTemplate/Execute/RefreshCache for more details.

/databases/ASAssets/CacheManagement/CacheFramework/UpdateResourceOwner()
This procedure is used to change resource ownership of a resource. This script can be used to change ownership of a single resource or a folder with multiple resources. By default the ownership is pushed recursively to all the resources in a folder. This script uses the admin interface providing elevated privileges to perform this action.

Executing the library function used in this script requires ACCESS TOOLS, READ ALL RESOURCES, READ ALL USERS role, therefore ideally, this script should be executed by an Admin user.

Admin Interface Procedures

The admin interface procedures serve the purpose of allowing a user to execute a procedure with elevated rights by redirecting the procedure through an admin interface DV internal data source where the user has admin rights.

`<CF_Folder>`**/Scripts/AdminInterface/ClearPlanCache()**
This procedure is designed to clear the plan cache. This script uses the admin interface providing elevated privileges to perform this action.

`<CF_Folder>`**/Scripts/AdminInterface /ClearRepositoryCache()**
This procedure is designed to clear the repository cache. This script uses the admin interface providing elevated privileges to perform this action.

`<CF_Folder>`**/Scripts/AdminInterface /ConfigureCache()**
This procedure uses the admin interface providing elevated privileges to perform this action. Refer back to ApplicationTemplate/Execute/ConfigureCache for more details.

`<CF_Folder>`**/Scripts/AdminInterface /ConfigureCache_Multi_Table()**
This procedure uses the admin interface providing elevated privileges to perform this action. Refer back to ApplicationTemplate/Execute/ConfigureCache_Multi_Table for more details.

<CF_Folder>/**Scripts/AdminInterface /ConfigureCacheAdhoc()**

This procedure provides a way of configuring a cache view in an adhoc way bypassing the CachingData() procedure. This script uses the admin interface providing elevated privileges to perform this action. Refer back to ApplicationTemplate/Execute/ConfigureCacheAdhoc for more details.

<CF_Folder>/**Scripts/AdminInterface /CopyPrivilegesFromParent()**

This procedure is designed to push privileges to a newly create resource and makes is same as the parent folder in which the resource exists. This script uses the admin interface providing elevated privileges to perform this action.

The script takes a resource name with path and resource type as input parameter and returns SUCCESS or FAIL as output message. Additional logging is done in AUDIT_LOG table as well as in cs_server.log file. This script requires the user executing the script to have GRANT privileges on the source folder.

<CF_Folder>/**Scripts/AdminInterface /DeconfigureCache()**

This procedure is used to de-configure the cache. Refer back to ApplicationTemplate/Execute/DeconfigureCache for more details.

<CF_Folder>/**Scripts/AdminInterface /IntrospectTables()**

This procedure is used to provide a consistent and generic interface for introspecting database tables. This script uses the admin interface providing elevated privileges to perform this action.

<CF_Folder>/**Scripts/AdminInterface /RefreshCache()**

This procedure is used to kick off a cache refresh on a resource. Currently the default resource type is set to TABLE. This script uses the admin interface providing elevated privileges to perform this action. Refer back to ApplicationTemplate/Execute/RefreshCache for more details.

<CF_Folder>/**Scripts/AdminInterface /UpdateResourceOwner()**

This procedure is used to change resource ownership of a resource. This script can be used to change ownership of a single resource or a folder with multiple resources. By default, the ownership is pushed recursively to all the resources in a folder. This script uses the admin interface providing elevated privileges to perform this action.

Executing the library function used in this script requires ACCESS TOOLS, READ ALL RESOURCES, READ ALL USERS role, therefore ideally, this script should be executed by an Admin user.

8 Appendix A – Configure Cache Framework Sample

The following is a discussion of how to augment the Cache Framework.

Configuring the Cache Framework Sample

Configuring the Cache Framework sample is a one-time action that should be done by a DV architect with overall knowledge of the application and cache database target. There is a sample for each cache database type.

Background Information

1) Samples include Application Template, Views and System of Record (SOR):
2) Purpose – The purpose of the sample is two-fold.
    a. It provides a readymade data source that can be used for quickly learning and demonstrating the Cache Framework capabilities.
    b. It serves as a base-line for testing the Cache Framework and verifying supported data types.
3) Assumptions: The Cache Framework has been installed at this location `<CS_Folder>`:

    `/shared/ASAssets/CacheManagement/CacheFrameworkSample`

4) Configure Oracle Sample
    a. `<CS_Folder>`/Oracle_Application – Cache Framework template for Oracle.
    b. `<CS_Folder>`/Oracle_SampleViews – Sample views to configure caching with.
    c. `<CS_Folder>`/Oracle_SampleSOR – Sample system of record database and scripts.
5) Configure SQL Server Sample
    a. `<CS_Folder>`/SqlServer_Application – Cache Framework template for SQL Server.
    b. `<CS_Folder>`/SqlServer_SampleViews – Sample views to configure caching with.
    c. `<CS_Folder>`/SqlServer_SampleSOR – Sample system of record database and scripts.
6) Configure Netezza Sample
    a. `<CS_Folder>`/Netezza_Application – Cache Framework template for Netezza.
    b. `<CS_Folder>`/Netezza_SampleViews – Sample views to configure caching with.
    c. `<CS_Folder>`/Netezza_SampleSOR – Sample system of record database and scripts.
7) Configure MemSql Sample
    a. `<CS_Folder>`/MemSql_Application – Cache Framework template for MemSql.
    b. `<CS_Folder>`/MemSql_SampleViews – Sample views to configure caching with.
    c. `<CS_Folder>`/MemSql_SampleSOR – Sample system of record database and scripts.

8) Configure Postgres Sample
   a. <CS_Folder>/Postgres_Application – Cache Framework template for Postgres.
   b. <CS_Folder>/Postgres_SampleViews – Sample views to configure caching with.
   c. <CS_Folder>/Postgres_SampleSOR – Sample system of record database and scripts.

Configure Oracle Sample:

1) Application
   a. Location: <CS_Folder>/Oracle_Application
   b. Provides a cache target configured sample. It originated from <CF_Folder>/ApplicationTemplateOracle. It points to the Oracle SOR for a cache target data source.
2) Views
   a. Location: <CS_Folder>/Oracle_SampleViews
   b. Provides a sample view for each cache type. The CachingData procedure is already configured for this sample for the default location of the Cache Framework Sample. There is also a view that exercises the different data types. These views provide a baseline for testing and examples.
3) SOR
   a. Location: <CS_Folder>/Oracle_SampleSOR
   b. The SAMPLE_DS serves as both a system or record and the cache target database to simplify the connectivity for this sample.
4) **Configure Oracle system of record samples**
   a. Select an Oracle database for creating a sample system of record
      i. Create a user/schema with the name “CIS_CACHE”
      ii. Grant the user the ability to do the following:

```
-- Provide password and tablespace details
CREATE USER CIS_CACHE IDENTIFIED BY <password> default tablespace ts_users temporary tablespace temp;
GRANT CREATE SESSION TO CIS_CACHE;
GRANT CREATE SEQUENCE TO CIS_CACHE;
GRANT CREATE TABLE TO CIS_CACHE;
GRANT CREATE ANY INDEX TO CIS_CACHE;
GRANT CREATE TRIGGER TO CIS_CACHE;
GRANT DROP ANY SEQUENCE TO CIS_CACHE;
GRANT DROP ANY TABLE TO CIS_CACHE;
GRANT DROP ANY INDEX TO CIS_CACHE;
GRANT DROP ANY TRIGGER TO CIS_CACHE;
GRANT ALTER SESSION TO CIS_CACHE;
```

```
COMMIT;
-- Provide password and Database SID
CONNECT CIS_CACHE/<password>@<DB>;
ALTER SESSION SET NLS_LANGUAGE=American;
ALTER SESSION SET NLS_TERRITORY=America;
COMMIT;
```

iii. Note: if a different schema is provided then the scripts will need to be rebound to that database and user once all of the tables are created and introspected.

b. Open the SAMPLE_DS data source connection.
   i. Edit the connection details to point to the new
   ii. Click “Test Connection” to verify that the connection is working.

c. Execute create_TEST_INCR to create the following:
   i. TEST_INCR
   ii. TEST_INCR_DEL
   iii. TEST_INCR_HIST
   iv. TEST_INCR_TRIGGER
   v. TEST_INCR_DEL_TRIGGER

d. Re-introspect the SAMPLE_DS data source.

e. Validate the SOR tables.
   i. Right click on ../SOR/TEST_INCR and "Execute" to insure no error is thrown.
   ii. Repeat for TEST_INCR_DEL
   iii. Repeat for TEST_INCR_HIST

f. Insert/Update/Delete rows as needed to test various cache types:
   i. insert_TEST_INCR
   ii. update_TEST_INCR
   iii. deletePK_TEST_INCR

5) **Configure Oracle Application Template**

a. RebindPackagedQueries
   i. Location: `<CS_Folder>`/Oracle_Application/Initialize/RebindPackagedQueries
   ii. Execute to rebind the two packaged queries [ExecuteDDL and GetIntResult] to the SAMPLE_DS data source. There are no input

parameters. The information for rebinding is contained within the Constants procedure.

b. Initialize database tables

i. Location: <CS_Folder>/Oracle_Application/Initialize

ii. ***CreateDBSequence*** : Create DB sequence CACHE_FRAMEWORK_SEQ. Does not drop automatically.

iii. ***Create_AUDIT_LOG*** : Will automatically drop if exists.

iv. ***Create_AUDIT_LOG_SEQ*** : Will automatically drop if exists.

v. ***Create_CACHING_DATA*** : Will automatically drop if exists.

c. Execute CachingData_Insert procedure

i. Location: <CS_Folder>/Oracle_Application/DataScripts

ii. ***CachingData_Insert(1)*** – Execute to load rows into CACHING_DATA table. Provide a 1 to delete existing rows before inserting.

6) **Cache Configuration Generation**

a. **ConfigureCache**

i. Location: <CS_Folder>/Oracle_Application/Execute/ConfigureCache

ii. Configure view cache, scripts, schedule and database tables.

iii. Input: The path to view to be configured:

/shared/ASAssets/CacheManagement/CacheFrameworkSample/Oracle_SampleViews/Views/V_TEST_INCR_HYB_N

b. **ConfigureCache_Multi_Table**

i. Location: <CS_Folder>/Oracle_Application/Execute/ConfigureCache_Multi_Table

ii. Configure CachingData procedure, view cache, scripts and database tables.

iii. Input: The path to view to be configured:

/shared/ASAssets/CacheManagement/CacheFrameworkSample/Oracle_SampleViews/Views/V_TEST_FULL_MULTI

c. **RefreshCache**

i. Location: <CS_Folder>/Oracle_Application/Execute/RefreshCache

ii. Refresh the cache.

iii. Input: The path to view to be configured:

/shared/ASAssets/CacheManagement/CacheFrameworkSample/Oracle_SampleViews/Views/V_TEST_INCR_HYB_N

d. **AuditLogDisplay**
   i. Report on the outcome of the cache or configuration.
   ii. Location: <CS_Folder>/Oracle_Application/Execute/AuditLogDisplay
   iii. Input: leave all blank to select all.

e. **DeconfigureCache**
   i. De-configure cache, scripts and database tables.
   ii. Location: <CS_Folder>/Oracle_Application/Execute/DeconfigureCache
   iii. Input: The path to view to be configured:

   /shared/ASAssets/CacheManagement/CacheFrameworkSample/Oracle_SampleViews/Views/V_TEST_INCR_HYB_N

Configure SQL Server Sample:

1) Application
   a. Location: <CS_Folder>/SqlServer_Application
   b. Provides a cache target configured sample. It originated from <CF_Folder>/ApplicationTemplateSqlServer. It points to the Sql Server SOR for a cache target data source.
2) Views
   a. Location: <CS_Folder>/SqlServer_SampleViews
   b. Provides a sample view for each cache type. The CachingData procedure is already configured for this sample for the default location of the Cache Framework Sample. There is also a view that exercises the different data types. These views provide a baseline for testing and examples.
3) SOR
   a. Location: <CS_Folder>/SqlServer_ampleSOR
   b. The SAMPLE_DS serves as both a system or record and the cache target database to simplify the connectivity for this sample.
4) **Configure SQL Server system of record samples**
   a. Select a SQL Server database for creating a sample system of record
      i. Create a catalog with the name “CIS_CACHE” and schema “dbo”. Create a user CIS_CACHE.
      ii. Grant the user the ability to do the following:

```
USE [CIS_CACHE];
GRANT CREATE SEQUENCE ON SCHEMA::dbo TO [CIS_CACHE];
GRANT CREATE TABLE TO [CIS_CACHE];
GRANT ALTER ON SCHEMA::dbo TO [CIS_CACHE];
```

```
GO;
```

iii. Note: if a different catalog and schema is provided then the scripts will need to be rebound to that database and user once all of the tables are created and introspected.

b. Open the SAMPLE_DS data source connection.
   i. Click “Test Connection” to verify that the connection is working.

c. Create database objects
   i. SQL Server 2012 - Execute /SQL2012/create_TEST_INCR to create the following:
      1. TEST_INCR
      2. TEST_INCR_DEL
      3. TEST_INCR_HIST
      4. TEST_INCR_TRIGGER
      5. TEST_INCR_DEL_TRIGGER
   ii. SQL Server 2008 - Execute /SQL2008/create_TEST_INCR_2008 to create the following:
      1. TEST_INCR
      2. TEST_INCR_DEL
      3. TEST_INCR_HIST

d. Re-introspect the SAMPLE_DS data source.

e. Validate the SOR tables.
   i. Right click on ../SOR/TEST_INCR and "Execute" to insure no error is thrown.
   ii. Repeat for TEST_INCR_DEL
   iii. Repeat for TEST_INCR_HIST

f. Insert/Update/Delete rows as needed using various scripts:
   i. SQL Server 2012
      1. /SQL2012/insert_TEST_INCR
      2. /SQL2012/update_TEST_INCR
      3. /SQL2012/deletePK_TEST_INCR
   ii. SQL Server 2008
      1. /SQL2008/insert_TEST_INCR_2008
      2. /SQL2008/update_TEST_INCR_2008

3. /SQL2008/deletePK_TEST_INCR_2008

5) **Configure SQL Server Application Template**

   a. RebindPackagedQueries

      i. Location:
      <CS_Folder>/SqlServer_Application/Initialize/RebindPackagedQueries

      ii. Execute to rebind the two packaged queries [ExecuteDDL and GetIntResult] to the SAMPLE_DS data source. There are no input parameters. The information for rebinding is contained within the Constants procedure.

   b. Initialize database tables

      i. Location: <CS_Folder>/SqlServer_Application/Initialize

      ii. ***CreateDBSequence*** : Create DB sequence CACHE_FRAMEWORK_SEQ. Does not drop automatically.

      iii. ***Create_AUDIT_LOG*** : Will automatically drop if exists.

      iv. ***Create_AUDIT_LOG_SEQ*** : Will automatically drop if exists.

      v. ***Create_CACHING_DATA*** : Will automatically drop if exists.

      vi. Execute CachingData_Insert procedure

         1. Location: <CS_Folder>/SqlServer_Application/DataScripts

         2. ***CachingData_Insert(1)*** – Execute to load rows into CACHING_DATA table. Provide a 1 to delete existing rows before inserting.

6) **Cache Configuration Generation**

   a. **ConfigureCache**

      i. Location: <CS_Folder>/SqlServer_Application/Execute/ConfigureCache

      ii. Configure cache, scripts, schedule and database tables.

      iii. Input: The path to view to be configured:

      /shared/ASAssets/CacheManagement/CacheFrameworkSample/SqlServer_SampleViews/Views/V_TEST_INCR_HYB_N

   b. **ConfigureCache_Multi_Table**

      i. Location:
      <CS_Folder>/SqlServer_Application/Execute/ConfigureCache_Multi_Table

      ii. Configure CachingData procedure, view cache, scripts and database tables.

      iii. Input: The path to view to be configured:

/shared/ASAssets/CacheManagement/CacheFrameworkSample/SqlServer_SampleViews/Views/V_TEST_FULL_MULTI

c. **RefreshCache**
   i. Location: <CS_Folder>/SqlServer_Application/Execute/RefreshCache
   ii. Refresh the cache.
   iii. Input: The path to view to be configured:

   /shared/ASAssets/CacheManagement/CacheFrameworkSample/SqlServer_SampleViews/Views/V_TEST_INCR_HYB_N

d. **AuditLogDisplay**
   i. Location: <CS_Folder>/SqlServer_Application/Execute/AuditLogDisplay
   ii. Report on the outcome of the cache or configuration.
   iii. Input: leave all blank to select all.

e. **DeconfigureCache**
   i. Location: <CS_Folder>/SqlServer_Application/Execute/DeconfigureCache
   ii. De-configure cache, scripts and database tables.
   iii. Input: The path to view to be configured:

   /shared/ASAssets/CacheManagement/CacheFrameworkSample/SqlServer_SampleViews/Views/V_TEST_INCR_HYB_N

Configure Netezza Sample:

1) Application
   a. Location: <CS_Folder>/Netezza_Application
   b. Provides a cache target configured sample. It originated from <CF_Folder>/ApplicationTemplateNetezza. It points to the Netezza SOR for a cache target data source.
2) Views
   a. Location: <CS_Folder>/Netezza_SampleViews
   b. Provides a sample view for each cache type. The CachingData procedure is already configured for this sample for the default location of the Cache Framework Sample. There is also a view that exercises the different data types. These views provide a baseline for testing and examples.
3) SOR
   a. Location: <CS_Folder>/Netezza_SampleSOR
   b. The SAMPLE_DS serves as both a system or record and the cache target database to simplify the connectivity for this sample.

4) **Configure Netezza system of record samples**

   a. Select a Netezza database for creating a sample system of record

      i. Create a database in the Netezza data source called "CIS_CACHE" owned by the user ADMIN.

      ii. Grant the user the ability to do the following:

```
GRANT LIST ON ADMIN TO ADMIN ;
GRANT CREATE SEQUENCE TO ADMIN ;
GRANT CREATE TABLE TO ADMIN ;
GRANT DROP ON SEQUENCE TO ADMIN ;
GRANT DROP ON TABLE TO ADMIN ;
COMMIT;
```

      iii. Note: if a different database and user is provided then the scripts will need to be rebound to that database and user once all of the tables are created and introspected.

   b. Open the SAMPLE_DS data source connection.

      i. Edit the connection details to point to the new

      ii. Click “Test Connection” to verify that the connection is working.

   c. Execute create_TEST_INCR to create the following:

      i. TEST_INCR

      ii. TEST_INCR_DEL

      iii. TEST_INCR_HIST

   d. Re-introspect the SAMPLE_DS data source.

   e. Validate the SOR tables.

      i. Right click on ../SOR/TEST_INCR and "Execute" to insure no error is thrown.

      ii. Repeat for TEST_INCR_DEL

      iii. Repeat for TEST_INCR_HIST

   f. Insert/Update/Delete rows as needed to test various cache types:

      i. insert_TEST_INCR

      ii. update_TEST_INCR

      iii. deletePK_TEST_INCR

5) **Configure Netezza Application Template**

   a. RebindPackagedQueries

      i. Location: <CS_Folder>/Netezza_Application/Initialize/RebindPackagedQueries

ii. Execute to rebind the two packaged queries [ExecuteDDL and GetIntResult] to the SAMPLE_DS data source. There are no input parameters. The information for rebinding is contained within the Constants procedure.

b. Initialize database tables

i. Location: <CS_Folder>/Netezza_Application/Initialize

ii. ***CreateDBSequence*** : Create DB sequence CACHE_FRAMEWORK_SEQ. Does not drop automatically.

iii. ***Create_AUDIT_LOG*** : Will automatically drop if exists.

iv. ***Create_AUDIT_LOG_SEQ*** : Will automatically drop if exists.

v. ***Create_CACHING_DATA*** : Will automatically drop if exists.

c. Execute CachingData_Insert procedure

i. Location: <CS_Folder>/Netezza_Application/DataScripts

ii. ***CachingData_Insert(1)*** – Execute to load rows into CACHING_DATA table. Provide a 1 to delete existing rows before inserting.

6) **Cache Configuration Generation**

a. **ConfigureCache**

i. Location: <CS_Folder>/Netezza_Application/Execute/ConfigureCache

ii. Configure cache, scripts, schedule and database tables.

iii. Input: The path to view to be configured:

/shared/ASAssets/CacheManagement/CacheFrameworkSample/Netezza_SampleViews/Views/V_TEST_INCR_HYB_N

b. **ConfigureCache_Multi_Table**

i. Location: <CS_Folder>/Netezza_Application/Execute/ConfigureCache_Multi_Table

ii. Configure CachingData procedure, view cache, scripts and database tables.

iii. Input: The path to view to be configured:

/shared/ASAssets/CacheManagement/CacheFrameworkSample/Netezza_SampleViews/Views/V_TEST_FULL_MULTI

c. **RefreshCache**

i. Location: <CS_Folder>/Netezza_Application/Execute/RefreshCache

ii. Refresh the cache.

iii. Input: The path to view to be configured:

/shared/ASAssets/CacheManagement/CacheFrameworkSample/Netezza_Sample Views/Views/V_TEST_INCR_HYB_N

d. **AuditLogDisplay**
   i. Location: <CS_Folder>/Netezza_Application/Execute/AuditLogDisplay
   ii. Report on the outcome of the cache or configuration.
   iii. Input: leave all blank to select all.

e. **DeconfigureCache**
   i. Location: <CS_Folder>/Netezza_Application/Execute/DeconfigureCache
   ii. De-configure cache, scripts and database tables.
   iii. Input: The path to view to be configured:

   /shared/ASAssets/CacheManagement/CacheFrameworkSample/Netezza_Sample Views/Views/V_TEST_INCR_HYB_N

Configure MemSql Sample:

1) Application
   a. Location: <CS_Folder>/MemSql_Application
   b. Provides a cache target configured sample. It originated from <CF_Folder>/ApplicationTemplateMemSql. It points to the MemSql SOR for a cache target data source.
2) Views
   a. Location: <CS_Folder>/MemSql_SampleViews
   b. Provides a sample view for each cache type. The CachingData procedure is already configured for this sample for the default location of the Cache Framework Sample. There is also a view that exercises the different data types. These views provide a baseline for testing and examples.
3) SOR
   a. Location: <CS_Folder>/MemSql_SampleSOR
   b. The SAMPLE_DS serves as both a system or record and the cache target database to simplify the connectivity for this sample.
4) **Configure MemSql system of record samples**
   a. Select an MemSql database for creating a sample system of record
      i. Create a user/schema with the name “ciscache”
      ii. Grant the user the ability to do the following:

      GRANT CREATE SEQUENCE TO ciscache ;

      GRANT CREATE TABLE TO ciscache ;

      GRANT CREATE TRIGGER TO ciscache ;

```
GRANT CREATE SESSION TO ciscache ;
GRANT CREATE ANY INDEX TO ciscache ;
GRANT DROP ANY SEQUENCE TO ciscache ;
GRANT DROP ANY TABLE TO ciscache ;
GRANT DROP ANY TRIGGER TO ciscache ;
GRANT DROP ANY INDEX TO ciscache ;
GRANT ALTER SESSION TO ciscache ;
COMMIT;
```

iii. Note: if a different schema is provided then the scripts will need to be rebound to that database and user once all of the tables are created and introspected.

b. Open the SAMPLE_DS data source connection.
   i. Edit the connection details to point to the new
   ii. Click “Test Connection” to verify that the connection is working.

c. Execute create_TEST_INCR to create the following:
   i. TEST_INCR

d. Re-introspect the SAMPLE_DS data source.

e. Validate the SOR tables.
   i. Right click on ../SOR/TEST_INCR and "Execute" to insure no error is thrown.

f. Insert/Update/Delete rows as needed to test various cache types:
   i. insert_TEST_INCR
   ii. update_TEST_INCR
   iii. deletePK_TEST_INCR

5) **Configure MemSql Application Template**

a. RebindPackagedQueries
   i. Location: `<CS_Folder>`/MemSql_Application/Initialize/RebindPackagedQueries
   ii. Execute to rebind the two packaged queries [ExecuteDDL and GetIntResult] to the SAMPLE_DS data source. There are no input parameters. The information for rebinding is contained within the Constants procedure.

b. Initialize database tables
   i. Location: `<CS_Folder>`/MemSql_Application/Initialize
   ii. ***CreateDBSequence*** : Create DB sequence CACHE_FRAMEWORK_SEQ. Does not drop automatically.

iii. ***Create_AUDIT_LOG*** : Will automatically drop if exists.

iv. ***Create_AUDIT_LOG_SEQ*** : Will automatically drop if exists.

v. ***Create_CACHING_DATA*** : Will automatically drop if exists.

c. Execute CachingData_Insert procedure

i. Location: `<CS_Folder>`/MemSql_Application/DataScripts

ii. ***CachingData_Insert(1)*** – Execute to load rows into CACHING_DATA table. Provide a 1 to delete existing rows before inserting.

6) **Cache Configuration Generation**

a. **ConfigureCache**

i. Location: `<CS_Folder>`/MemSql_Application/Execute/ConfigureCache

ii. Configure view cache, scripts, schedule and database tables.

iii. Input: The path to view to be configured:

/shared/ASAssets/CacheManagement/CacheFrameworkSample/MemSql_Sample Views/Views/V_TEST_FULL_SINGLE

b. **ConfigureCache_Multi_Table**

i. Location: `<CS_Folder>`/MemSql_Application/Execute/ConfigureCache_Multi_Table

ii. Configure CachingData procedure, view cache, scripts and database tables.

iii. Input: The path to view to be configured:

/shared/ASAssets/CacheManagement/CacheFrameworkSample/MemSql_Sample Views/Views/V_TEST_FULL_MULTI

c. **RefreshCache**

i. Location: `<CS_Folder>`/MemSql_Application/Execute/RefreshCache

ii. Refresh the cache.

iii. Input: The path to view to be configured:

/shared/ASAssets/CacheManagement/CacheFrameworkSample/MemSql_Sample Views/Views/V_TEST_FULL_SINGLE

d. **AuditLogDisplay**

i. Report on the outcome of the cache or configuration.

ii. Location: `<CS_Folder>`/MemSql_Application/Execute/AuditLogDisplay

iii. Input: leave all blank to select all.

e. **DeconfigureCache**

i. De-configure cache, scripts and database tables.

ii. Location: <CS_Folder>/MemSql_Application/Execute/DeconfigureCache

iii. Input: The path to view to be configured:

/shared/ASAssets/CacheManagement/CacheFrameworkSample/MemSql_SampleViews/Views/V_TEST_FULL_SINGLE

Configure Postgres Sample:

1) Application
   a. Location: <CS_Folder>/Postgres_Application
   b. Provides a cache target configured sample. It originated from <CF_Folder>/ApplicationTemplatePostgres. It points to the Postgres SOR for a cache target data source.
2) Views
   a. Location: <CS_Folder>/Postgres_SampleViews
   b. Provides a sample view for each cache type. The CachingData procedure is already configured for this sample for the default location of the Cache Framework Sample. There is also a view that exercises the different data types. These views provide a baseline for testing and examples.
3) SOR
   a. Location: <CS_Folder>/Postgres_SampleSOR
   b. The SAMPLE_DS serves as both a system or record and the cache target database to simplify the connectivity for this sample.
4) **Configure Postgres system of record samples**
   a. Select an Postgres database for creating a sample system of record
      i. Create a user/schema with the name “ciscache”
      ii. Grant the user the ability to do the following:

```
GRANT CREATE SEQUENCE TO ciscache ;
GRANT CREATE TABLE TO ciscache ;
GRANT CREATE TRIGGER TO ciscache ;
GRANT CREATE SESSION TO ciscache ;
GRANT CREATE ANY INDEX TO ciscache ;
GRANT DROP ANY SEQUENCE TO ciscache ;
GRANT DROP ANY TABLE TO ciscache ;
GRANT DROP ANY TRIGGER TO ciscache ;
GRANT DROP ANY INDEX TO ciscache ;
GRANT ALTER SESSION TO ciscache ;
COMMIT;
```

iii. Note: if a different schema is provided then the scripts will need to be rebound to that database and user once all of the tables are created and introspected.

b. Open the SAMPLE_DS data source connection.
   i. Edit the connection details to point to the new
   ii. Click “Test Connection” to verify that the connection is working.

c. Execute create_TEST_INCR to create the following:
   i. TEST_INCR

d. Re-introspect the SAMPLE_DS data source.

e. Validate the SOR tables.
   i. Right click on ../SOR/TEST_INCR and "Execute" to insure no error is thrown.

f. Insert/Update/Delete rows as needed to test various cache types:
   i. insert_TEST_INCR
   ii. update_TEST_INCR
   iii. deletePK_TEST_INCR

5) **Configure Oracle Application Template**

a. RebindPackagedQueries
   i. Location: `<CS_Folder>`/Postgres_Application/Initialize/RebindPackagedQueries
   ii. Execute to rebind the two packaged queries [ExecuteDDL and GetIntResult] to the SAMPLE_DS data source. There are no input parameters. The information for rebinding is contained within the Constants procedure.

b. Initialize database tables
   i. Location: `<CS_Folder>`/Postgres_Application/Initialize
   ii. ***CreateDBSequence*** : Create DB sequence CACHE_FRAMEWORK_SEQ. Does not drop automatically.
   iii. ***Create_AUDIT_LOG*** : Will automatically drop if exists.
   iv. ***Create_AUDIT_LOG_SEQ*** : Will automatically drop if exists.
   v. ***Create_CACHING_DATA*** : Will automatically drop if exists.

c. Execute CachingData_Insert procedure
   i. Location: `<CS_Folder>`/Postgres_Application/DataScripts

ii. ***CachingData_Insert(1)*** – Execute to load rows into CACHING_DATA table. Provide a 1 to delete existing rows before inserting.

6) **Cache Configuration Generation**

a. **ConfigureCache**

i. Location: `<CS_Folder>`/Postgres_Application/Execute/ConfigureCache

ii. Configure view cache, scripts, schedule and database tables.

iii. Input: The path to view to be configured:

/shared/ASAssets/CacheManagement/CacheFrameworkSample/Postgres_Sample Views/Views/V_TEST_FULL_SINGLE

b. **ConfigureCache_Multi_Table**

i. Location: `<CS_Folder>`/Postgres_Application/Execute/ConfigureCache_Multi_Table

ii. Configure CachingData procedure, view cache, scripts and database tables.

iii. Input: The path to view to be configured:

/shared/ASAssets/CacheManagement/CacheFrameworkSample/Postgres_Sample Views/Views/V_TEST_FULL_MULTI

c. **RefreshCache**

i. Location: `<CS_Folder>`/Postgres_Application/Execute/RefreshCache

ii. Refresh the cache.

iii. Input: The path to view to be configured:

/shared/ASAssets/CacheManagement/CacheFrameworkSample/Postgres_Sample Views/Views/V_TEST_FULL_SINGLE

d. **AuditLogDisplay**

i. Report on the outcome of the cache or configuration.

ii. Location: `<CS_Folder>`/Postgres_Application/Execute/AuditLogDisplay

iii. Input: leave all blank to select all.

e. **DeconfigureCache**

i. De-configure cache, scripts and database tables.

ii. Location: `<CS_Folder>`/Postgres_Application/Execute/DeconfigureCache

iii. Input: The path to view to be configured:

/shared/ASAssets/CacheManagement/CacheFrameworkSample/Postgres_Sample Views/Views/V_TEST_FULL_SINGLE

9 Appendix B – Merge Cache Types

The following is a discussion of the different Merge cache types that are supported.

Merge Cache Types

Adding a new cache type involves the following:

Merge and Slowly Changing Dimensions [1]

Dimension is a term in data management and data warehousing. It's the logical groupings of data such as geographical location, customer or product information. With **Slowly Changing Dimensions (SCDs)** data changes slowly, rather than changing on a time-based, regular schedule.

For example, you may have a dimension in your database that tracks the sales records of your company's salespeople. Creating sales reports seems simple enough, until a salesperson is transferred from one regional office to another. How do you record such a change in your sales dimension?

You could calculate the sum or average of each salesperson's sales, but if you use that to compare the performance of salespeople, that might give misleading information. If the salesperson was transferred and used to work in a hot market where sales were easy, and now works in a market where sales are infrequent, his/her totals will look much stronger than the other salespeople in their new region. Or you could create a second salesperson record and treat the transferred person as a new sales person, but that creates problems.

Dealing with these issues involves SCD management methodologies referred to as Type 0 through 6. Type 6 SCDs are also sometimes called Hybrid SCDs.

Type 0

The **Type 0** method is passive. It manages dimensional changes and no action is performed. Values remain as they were at the time the dimension record was first inserted. In certain circumstances history is preserved with a Type 0. High order types are employed to guarantee the preservation of history whereas Type 0 provides the least or no control.

The most common types are I, II, and III.

Type 1

This methodology overwrites old with new data, and therefore does not track historical data. Example of a supplier table:

[1] See Wikipedia Slowly Changing Dimensions example by Bruce Ottman and Ralph Kimball

Supplier_Key	Supplier_Code	Supplier_Name	Supplier_State
123	ABC	Acme Supply Co	CA

In the above example, Supplier_Code is the *natural key* and Supplier_Key is a *surrogate key*. Technically, the surrogate key is not necessary, since the row will be unique by the natural key (Supplier_Code). However, to optimize performance on joins use integer rather than character keys. If the supplier relocates the headquarters to Illinois the record would be overwritten:

Supplier_Key	Supplier_Code	Supplier_Name	Supplier_State
123	ABC	Acme Supply Co	IL

The disadvantage of the Type I method is that there is no history in the data warehouse. It has the advantage however that it's easy to maintain.

If you have calculated an aggregate table summarizing facts by state, it will need to be recalculated when the Supplier_State is changed.

Type 2

This method tracks historical data by creating multiple records for a given *natural key* in the dimensional tables with separate *surrogate keys* and/or different version numbers. Unlimited history is preserved for each insert.

For example, if the supplier relocates to Illinois the version numbers will be incremented sequentially:

Supplier_Key	Supplier_Code	Supplier_Name	Supplier_State	Version.
123	ABC	Acme Supply Co	CA	0
124	ABC	Acme Supply Co	IL	1

Another method is to add 'effective date' columns.

Supplier_Key	Supplier_Code	Supplier_Name	Supplier_State	Start_Date	End_Date
123	ABC	Acme Supply Co	CA	01-Jan-2000	21-Dec-2004
124	ABC	Acme Supply Co	IL	22-Dec-2004	

The null End_Date in row two indicates the current tuple version. In some cases, a standardized surrogate high date (e.g. 9999-12-31) may be used as an end date, so that the field can be included in an index, and so that null-value substitution is not required when querying.

Transactions that reference a particular *surrogate key* (Supplier_Key) are then permanently bound to the time slices defined by that row of the slowly changing dimension table. An aggregate table summarizing facts by state continues to reflect the historical state, i.e. the state the supplier was in at the time of the transaction; no update is needed.

If there are retrospective changes made to the contents of the dimension, or if new attributes are added to the dimension (for example a Sales_Rep column) which have different effective dates from those already defined, then this can result in the existing transactions needing to be updated to reflect the new situation. This can be an expensive database operation, so Type 2 SCDs are not a good choice if the dimensional model is subject to change.

Type 3

This method tracks changes using separate columns and preserves limited history. The Type 3 preserves limited history as it is limited to the number of columns designated for storing historical data. The original table structure in Type 1 and Type 2 is the same but Type III adds additional columns. In the following example, an additional column has been added to the table to record the supplier's original state - only the previous history is stored.

Supplier_Key	Supplier_Code	Supplier_Name	Original_Supplier_State	Effective_Date	Current_Supplier_State
123	ABC	Acme Supply Co	CA	22-Dec-2004	IL

This record contains a column for the original state and current state—cannot track the changes if the supplier relocates a second time.

One variation of this is to create the field Previous_Supplier_State instead of Original_Supplier_State which would track only the most recent historical change.

Type 4 (CDC style)

The **Type 4** method is usually referred to as using "history tables", where one table keeps the current data and an additional table is used to keep a record of some or all changes. Both the surrogate keys are referenced in the Fact table to enhance query performance.

For the above example the original table name is **Supplier** and the history table is **Supplier_History.**

Supplier:

Supplier_key	Supplier_Code	Supplier_Name	Supplier_State
123	ABC	Acme Supply Co	IL

Supplier_History:

Supplier_key	Supplier_Code	Supplier_Name	Supplier_State	Create_Date
123	ABC	Acme Supply Co	CA	22-Dec-2004

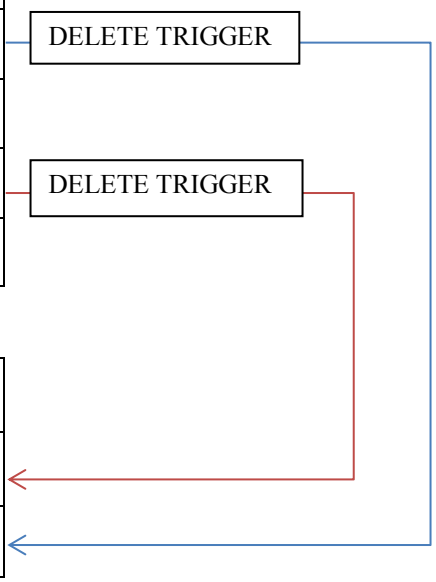
This method resembles how database audit tables and ***change data capture*** techniques function.

Merge Type 1 – Cache Framework Example

1) This methodology overwrites old with new data, and therefore does not track historical data. The implementation shown below does incorporate a start date which can be used to find changes to the "AS-IS" data. History is not maintained with a type 1 table.
2) Uses a "delete" history table to capture deletes only. One possible mechanism for capturing deletes is a trigger.
3) The Cache Framework will key off of both the system of record and history table for changes. The delta load scripts will look at the SDT timestamp field for changes greater than the last incremental cache refresh maintenance date to pull inserts or updates. The delta load script will look at the delete history table for deletes where the SDT timestamp field is greater than the cache refresh maintenance date.
4) The following is a description of the interaction between a system of record table and a "delete" history table.
5) SEQ = table sequence, K1 = primary key column 1, K2 = primary key column 2, SDT = Start Date

System of Record Table:

SEQ	K1	K2	C3	C4	SDT
~~4~~	~~11~~	~~id1~~	~~Desc1~~	~~1.00~~	~~2014-11-16 14:00:00~~
2	12	id2	Desc2	2.00	2014-11-17 14:00:00
~~3~~	~~13~~	~~id3~~	~~Desc3~~	~~3.00~~	~~2014-11-18 14:00:00~~
4	14	id4	Desc4	4.00	2014-11-19 14:00:00



Delete Table:

SEQ	K1	K2	C3	C4	SDT
3	13	id3	Desc3	3.00	2014-11-20 10:00:00
1	11	id1	Desc1	1.00	2014-11-20 11:00:00

System of Record Table (Post Delete Operation):

SEQ	K1	K2	C3	C4	SDT

2	12	id2	Desc2	2.00	2014-11-17 14:00:00
4	14	id4	Desc4	4.00	2014-11-19 14:00:00

Merge Type 2 – Cache Framework Example

1) Uses a history table to capture inserts, updates and deletes. One possible mechanism for capturing inserts, updates and deletes is a trigger.
2) The Cache Framework will key off of both the system of record and history table for changes. The delta load scripts will look at the SDT timestamp field for changes greater than the last incremental cache refresh maintenance date to pull inserts or updates. The delta load script will look at the history table for deletes where the SDT timestamp field is greater than the cache refresh maintenance date and the EDT timestamp is not equal to the surrogate '1999-12-31 00:00:00' and the record does not exist in the system of record table.
3) The following is a description of the interaction between a system of record table and a history table.
4) SEQ = table sequence, K1 = primary key column 1, K2 = primary key column 2, SDT = Start Date, EDT = End Date [a surrogate key value of 9999-12-31 may be used to denote an end date so that the EDT value is not NULL when the record is not closed out.]

System of Record Table (Initial Insert Operations):

	SEQ	K1	K2	C3	C4	SDT	
I	1	11	id1	Desc1	1.00	2014-11-16 14:00:00	INSERT TRIGGER
I	2	12	id2	Desc2	2.00	2014-11-17 14:00:00	INSERT TRIGGER
I	3	13	id3	Desc3	3.00	2014-11-18 14:00:00	INSERT TRIGGER
I	4	14	id4	Desc4	4.00	2014-11-19 14:00:00	INSERT TRIGGER

History Table (Post SOR Insert):

SEQ	K1	K2	C3	C4	SDT	EDT
1	11	id1	Desc1	1.00	2014-11-16 14:00:00	1999-12-31 00:00:00
2	12	id2	Desc2	2.00	2014-11-17 14:00:00	1999-12-31 00:00:00
3	13	id3	Desc3	3.00	2014-11-18 14:00:00	1999-12-31 00:00:00

4	14	id4	Desc4	4.00	2014-11-19 14:00:00	1999-12-31 00:00:00

System of Record Table (Update and Delete Operation):

	SEQ	K1	K2	C3	C4	SDT	
	1	11	id1	Desc1	1.00	2014-11-16 14:00:00	
U	2	12	id2	**D2.1**	**2.01**	**2014-11-20 20:00:00**	UPDATE TRIGGER
	3	13	id3	Desc3	3.00	2014-11-18 14:00:00	
D	4	~~14~~	~~id4~~	~~Desc4~~	~~4.00~~	~~2014-11-19 14:00:00~~	DELETE TRIGGER

History Table (Post SOR Update and Delete):

SEQ	K1	K2	C3	C4	SDT	EDT
1	11	id1	Desc1	1.00	2014-11-16 14:00:00	1999-12-31 00:00:00
2	**12**	**id2**	Desc2	2.00	2014-11-17 14:00:00	**2014-11-20 20:00:00**
3	13	id3	Desc3	3.00	2014-11-18 14:00:00	1999-12-31 00:00:00
4	14	id4	Desc4	4.00	2014-11-19 14:00:00	**2014-11-20 10:00:00**
5	**14**	**id4**	**Desc4**	**4.00**	**2014-11-20 10:00:00**	**2014-11-20 10:00:00**
6	**12**	**id2**	**D2.1**	**2.01**	**2014-11-20 20:00:00**	**1999-12-31 00:00:00**

System of Record Table (Post Delete and Update Operation):

SEQ	K1	K2	C3	C4	SDT
1	11	id1	Desc1	1.00	2014-11-16 14:00:00
2	12	id2	D2.1	2.01	2014-11-20 20:00:00
3	13	id3	Desc3	3.00	2014-11-18 14:00:00

Merge Type 4 – Cache Framework Example

1) Also known as Change Data Capture (CDC) style of merge where it tracks changes based on an activity flag either in the table or through an external CDC process that acts upon the system of record and history table to keep both in synch.
2) The Cache Framework will key off of both the system of record and history table for changes. The delta load scripts will look at the SDT timestamp field for changes greater than the last incremental cache refresh maintenance date to pull inserts or updates. The delta load script will look at the history table for deletes where the SDT timestamp field is greater than the cache refresh maintenance date and ACTIVITY='D'.
3) Uses a history table to capture inserts, updates and deletes. One possible mechanism for capturing inserts, updates and deletes is a trigger.
4) The following is a description of the interaction between a system of record table and a history table.
5) SEQ = table sequence, K1 = primary key column 1, K2 = primary key column 2, SDT = Start Date, ACTIVITY = CDC flag such as I,U,D for insert, update, delete operation.

System of Record Table (Initial Insert Operations):

	SEQ	K1	K2	C3	C4	SDT	
I	1	11	id1	Desc1	1.00	2014-11-16 14:00:00	INSERT TRIGGER
I	2	12	id2	Desc2	2.00	2014-11-17 14:00:00	INSERT TRIGGER
I	3	13	id3	Desc3	3.00	2014-11-18 14:00:00	INSERT TRIGGER
I	4	14	id4	Desc4	4.00	2014-11-19 14:00:00	INSERT TRIGGER

History Table (Post SOR Insert):

SEQ	K1	K2	C3	C4	SDT	ACTIVITY
1	11	id1	Desc1	1.00	2014-11-16 14:00:00	I
2	12	id2	Desc2	2.00	2014-11-17 14:00:00	I
3	13	id3	Desc3	3.00	2014-11-18 14:00:00	I
4	14	id4	Desc4	4.00	2014-11-19 14:00:00	I

System of Record Table (Update and Delete Operation):

SEQ	K1	K2	C3	C4	SDT
1	11	id1	Desc1	1.00	2014-11-16 14:00:00
U → 2	12	id2	**D2.1**	**2.01**	**2014-11-20 20:00:00** → UPDATE TRIGGER
3	13	id3	Desc3	3.00	2014-11-18 14:00:00
D → ~~4~~	~~14~~	~~id4~~	~~Desc4~~	~~4.00~~	~~2014-11-19 14:00:00~~ → DELETE TRIGGER

History Table (Post SOR Update and Delete):

SEQ	K1	K2	C3	C4	SDT	ACTIVITY
1	11	id1	Desc1	1.00	2014-11-16 14:00:00	I
2	12	id2	Desc2	2.00	2014-11-17 14:00:00	I
3	13	id3	Desc3	3.00	2014-11-18 14:00:00	I
4	14	id4	Desc4	4.00	2014-11-19 14:00:00	I
5	**14**	**id4**	**Desc4**	**4.00**	**2014-11-20 10:00:00**	**D**
6	**12**	**id2**	**D2.1**	**2.01**	**2014-11-20 20:00:00**	**U**

System of Record Table (Post Delete and Update Operation):

SEQ	K1	K2	C3	C4	SDT
1	11	id1	Desc1	1.00	2014-11-16 14:00:00
2	12	id2	D2.1	2.01	2014-11-20 20:00:00
3	13	id3	Desc3	3.00	2014-11-18 14:00:00

10 Appendix C – Adding a New Cache Type

The following is a discussion of how to augment the Cache Framework.

Adding a New Cache Type to the Source Code

Adding a new cache type involves the following:

1) To add a new cache type, modify these procedures and create an implementation procedure
    a. Create a new implementation procedure that follows the pattern of one like
        i. GenerateCacheScriptsFullCallback
        ii. GenerateCacheScriptsHybridDeltaNoStage
        iii. GenerateCacheScriptsHybridDeltaStage
        iv. GenerateCacheScriptsIncremental
        v. GenerateCacheScriptsHybridDeltaMergeType1
        vi. GenerateCacheScriptsHybridDeltaMergeType2
        vii. GenerateCacheScriptsHybridDeltaMergeType4
    b. List of procedures to modify
        i. CommonTypes.ValidCacheTypesAll
        ii. ConfigureCacheScript
        iii. DeleteReloadCache
        iv. UpdateCacheConfiguration
        v. PublishedImpl/DeployCache
        vi. HelperScripts/ValidateTableDependency
    c. List of Template procedures to modify
        i. ApplicationTemplateMemSql/DataScripts/CachingData - example
        ii. ApplicationTemplateMemSql/Execute/ConfigureCacheAdhoc - comments
        iii. ApplicationTemplateOracle/DataScripts/CachingData - example
        iv. ApplicationTemplateOracle/Execute/ConfigureCacheAdhoc - comments
        v. ApplicationTemplateNetezza/DataScripts/CachingData - example
        vi. ApplicationTemplateNetezza/Execute/ConfigureCacheAdhoc - comments
        vii. ApplicationTemplatePostgres/DataScripts/CachingData - example

viii. ApplicationTemplatePostgres/Execute/ConfigureCacheAdhoc - comments

ix. ApplicationTemplateSqlServer/DataScripts/CachingData - example

x. ApplicationTemplateSqlServer/Execute/ConfigureCacheAdhoc - comments

11 Appendix D – Adding a New Cache Data Source Type

The following is a discussion of how to augment the Cache Framework when adding a new cache target data source.

Adding a New Cache Data Source to the Source Code

Adding a new cache type involves the following:

Assumptions:

- The Cache Framework has been installed at this location <CF_Folder>:

  /shared/ASAssets/CacheManagement/CacheFramework

- The Cache Framework Sample has been installed at this location <CS_Folder>:

  /shared/ASAssets/CacheManagement/CacheFrameworkSample

Step 1. Determine what features are supported by the database so they can be mapped to capabilities in the CommonTypes

1) Map TDV data types to native data types

Example: Oracle is shown as an example.
All DV types that are supported are listed in the first column "DV_TYPE".
The mapping exercise is to determine what the "NATIVE_TYPE" is by doing internet research and creating a sample cache table using V_TEST_DATATYPES. The DV adapter for the given data source will generate the data types. This will provide a way to determine what the mapping should be. Pay attention to what the min and max precision should be for CHAR, VARCHAR, NUMERIC, DECIMAL, BINARY and VARBINARY. Just because a data base supports one precision, does not mean that the DV data source adapter will support that. For example, it seems to be a general rule that DV supports NUMERIC/DECIMAL(1 through 38). Beyond that, DV will use a CLOB field.
The USE_PRECISION columns instructs "GenerateColumnMappings" to use the given precision from the DV view. Y=use precision. N=do not use precision. For example VARCHAR(255) would map to VARCHAR2(255). VARCHAR(4001) would map to CLOB with no precision.

```
SET OracleDataTypeMapping =
--DV_TYPE          NATIVE_TYPE      MIN_PRECISION,  MAX_PRECISION, USE_PRECISION
-- String types
'CHAR|             CHAR|           1|             2000|           Y
CHAR|              CLOB|           2001|          NULL|           N
VARCHAR|           VARCHAR2|        1|             4000|           Y
VARCHAR|           CLOB|           4001|          NULL|           N
LONGVARCHAR|       CLOB|           NULL|          NULL|           N
XML|               CLOB|           NULL|          NULL|           N
CLOB|              CLOB|           NULL|          NULL|           N
-- Boolean types
-- NOTE:  Even though BOOLEAN to NUMBER(1,0) is supported by the adapter, it is not supported for caching.
BOOLEAN|           NUMBER(1,0)|     NULL|          NULL|           N
-- Integer types
BIT|               NUMBER(1,0)|     NULL|          NULL|           N
TINYINT|           NUMBER(3,0)|     NULL|          NULL|           N
SMALLINT|          NUMBER(5,0)|     NULL|          NULL|           N
INTEGER|           NUMBER(10,0)|    NULL|          NULL|           N
BIGINT|            NUMBER(19,0)|    NULL|          NULL|           N
-- Decimal/Numeric types
DECIMAL|           NUMBER|         1|             38|           Y
DECIMAL|           CLOB|           39|          NULL|           N
NUMERIC|           NUMBER|         1|             38|           Y
```

```
NUMERIC|          CLOB|              39|          NULL|          N
DOUBLE|           BINARY_DOUBLE|    NULL|          NULL|          N
FLOAT|            BINARY_FLOAT|     NULL|          NULL|          N
REAL|             BINARY_FLOAT|     NULL|          NULL|          N
-- Date types
DATE|             DATE|             NULL|          NULL|          N
TIMESTAMP|        TIMESTAMP(9)|      NULL|          NULL|          N
TIME|             VARCHAR2(15)|     NULL|          NULL|          N
INTERVAL DAY|     VARCHAR2(30)|     NULL|          NULL|          N
INTERVAL MONTH|VARCHAR2(9)|         NULL|          NULL|          N
INTERVAL YEAR|    VARCHAR2(9)|      NULL|          NULL|          N
-- Binary types
BLOB|             BLOB|             NULL|          NULL|          N
BINARY|           BLOB|             1|             NULL|          N
VARBINARY|        RAW(1024)|         NULL|          NULL|          N';
```

2) Syntax for Table exists
3) Syntax for Index exists
4) Syntax for Create table
5) Syntax for Drop table
6) Syntax for Create index
7) Syntax for Create unique index
8) Syntax for Drop index
9) Syntax for Create sequence
10) Syntax for Drop sequence
11) Syntax for Get sequence
12) Syntax for Execute table statistics
13) Object begin and end separator such as " or `
14) Maximum object length including 2 characters for a separator
15) Syntax for Truncate table
16) Syntax for Merge operation
17) Example of a Merge operation
18) Syntax to convert string to timestamp - used in <CF_Folder>/Scripts/PublishedImpl/PurgeCacheData

Step 2. The purpose of this procedure is to provide guidance what to modify when porting to a new cache database.

1) Modify the following code resources
   1.
   a. <CF_Folder>/Scripts/CommonTypes
   b. <CF_Folder>/Scripts/ResetIncrMaintenanceLevel
   c. <CF_Folder>/Scripts/HelperScripts/CreateIndex
   d. <CF_Folder>/Scripts/HelperScripts/DropIndex
   e. <CF_Folder>/Scripts/HelperScripts/DropTable
   f. <CF_Folder>/Scripts/HelperScripts/ExecuteTableStatistics
   g. <CF_Folder>/Scripts/HelperScripts/GetDBResourceValue
      [used to test for database objects. Logic depends on syntax of <databasetype>ObjectTableExists and <databasetype>ObjectIndexExists]

2) Copy template <CF_Folder>/ApplicationTemplateOracle to <CF_Folder>/ApplicationTemplateNewDBType

   a. <CF_Folder>/ApplicationTemplateNewDBType/Constants/Constants
   b. <CF_Folder>/ApplicationTemplateNewDBType/DataScripts/CachingData

3) Copy sample <CF_Folder>Sample/Oracle_Application to <CF_Folder>Sample/NewDBType_SampleSOR

    a. Recreate the TEMP_DS datasource in the type of the cache database.
    b. <CF_Folder>Sample/NewDBType_Application/Constants/Constants
    c. <CF_Folder>Sample/NewDBType_Application/DataScripts/CachingData

4) Copy <CF_Folder>Sample/Oracle_SampleSOR to <CF_Folder>Sample/NewDBType_SampleSOR

    a. Recreate the SAMPLE_DS datasource in the type of the cache database.
    b. <CF_Folder>Sample/NewDBType_SampleSOR/SOR/create_TEST_INCR
    c. <CF_Folder>Sample/NewDBType_SampleSOR/SOR/insert_TEST_INCR

5) Copy <CF_Folder>Sample/Oracle_SampleViews to <CF_Folder>Sample/NewDBType_SampleViews and modify the source path

    a. <CF_Folder>Sample/NewDBType_SampleViews/Views/V_TEST_DATATYPES
    b. <CF_Folder>Sample/NewDBType_SampleViews/Views/V_TEST_FULL_MULTI
    c. <CF_Folder>Sample/NewDBType_SampleViews/Views/V_TEST_FULL_SINGLE
    d. <CF_Folder>Sample/NewDBType_SampleViews/Views/V_TEST_INCR

    -- Copy examples only if the cache data base supports merge otherwise they cannot be used.

    e. <CF_Folder>Sample/NewDBType_SampleViews/Views/V_TEST_INCR_HYB_MT1
    f. <CF_Folder>Sample/NewDBType_SampleViews/Views/V_TEST_INCR_HYB_MT2
    g. <CF_Folder>Sample/NewDBType_SampleViews/Views/V_TEST_INCR_HYB_MT4
    h. <CF_Folder>Sample/NewDBType_SampleViews/Views/V_TEST_INCR_HYB_N
    i. <CF_Folder>Sample/NewDBType_SampleViews/Views/V_TEST_INCR_HYB_S

6) Test the CommonTypes data mapping using the sample V_TEST_DATATYPES

    a. After manually creating the cache, excute the DDL and copy the syntax of the create. Compare the DDL with the CommonTypes data mapping. Whatever is being generated by the adapter for that database should match up with what was configured for the CommonTypes data mapping. Adjust the data mapping accordingly. Look for the min/max precision for CHAR, VARCHAR, DECIMAL, NUMERIC, BINARY and VARBINARY. Test the min/max based on what the database precisions are defined but be prepared to change them based on what the adapter supports.

    b. After the cache table has been created and introspected, execute the following procedure which should return a 0, SUCCESS if all of the view generated columns match the actual native types coming from the cached view. If a 1, SUCCESS is returned, then the there was a mismatch on the column types. Adjust the CommonTypes data mapping according to the native types.

    /shared/ASAssets/CacheManagement/CacheFramework/Scripts/HelperScripts/DeployCacheVerification

    c. It is very important that the DeployCacheVerification returns a 0 (match) so that "DeployCache" will work correctly and not indescriminately recreate cache tables since it invokes DeployCacheVerification to determine whether to create/recreate the tables or not.