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Tracking and Reporting Account Referral Activity using Hash tables and SAS BI

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ABSTRACT

One of the tasks of the analysis division at the bank is to keep track of new account referrals made by bank representatives based upon location, sales territory and manager. This is made more difficult because over time representatives may change their sales territory, no longer be active, report to different managers or more than one manager, or their reporting entities may change over time. The reporting requirements include being able to report on all activity based upon current sales territory and manager as well as to report on activity based upon sales territory and manager at the time the referral was made. Referrals by sales territory need to be able to report all referrals in that territory over a period of time by all representatives as well as only those sales made by currently active representatives. To handle these requirements, a slowly changing dimension table is created as part of a data warehouse. This table is maintained using the SAS hash object to reduce processing time. Reports are produced using SAS BI tools including OLAP cubes and web report studio. This paper demonstrates the use of the SAS hash object to maintain the table and provides examples of reporting techniques..

INTRODUCTION

Farm Bureau Bank was founded in 1999 to serve the membership of Farm Bureau Associations throughout the country providing retail banking services. Marketing to its customer base of Farm Bureau members is carried out predominantly through direct mail, referrals by participating states' Farm Bureau Insurance agents and internet marketing. Farm Bureau Insurance agents of participating states throughout the United States provide bank product referrals to their customers. Currently agent referrals provide approximately 90% of the new account applications with the remainder coming from direct mail or the internet. Agents are compensated for their referrals and there are incentives for the agents based on their account production. One of the responsibilities of the Finance/analytics area is to track the referral production of these insurance agents and provide reports to the agents, their managers and sales directors. The area is also responsible for calculating, reporting and paying commissions. Both referral and commission reports are distributed to members throughout the country using SAS BI allowing flexibility in terms of method and type of report distribution.

Accurate and timely reporting of account referrals is critical to maintaining the agents' willingness to refer business to the bank. This is made more difficult due to the structure of the agent relationships within the state. The state Farm Bureau Associations are independent entities with each Association having it own organizational structure. Some states structure their agents based upon counties, with each county having one or more agencies within the county, with each agency manager reporting to a county agency manager, and then going up to a district manager and state manager. Other states may have more than one county reporting to a manager and then having no district. As well as the different reporting structures, there is the usual churn among the agencies and managers. Over time agents may change counties, become agency managers, or become inactive. The reporting relationship may change as states redraw their districts, combine reporting entices or revamp their entire reporting structure.

Referral and commission reports must be able to deal with the continuing changes in the agent reporting relationship. In addition, because the number of referrals may influence the compensation of agency and district managers, accurate, timely and flexible reporting is necessary. For example, at times the total number of referrals by agent may be requested, independent of the agency or county associated with the agent. Other report requests may be based on the number of referrals by county, with the number of referrals made by agents during the assignment to the county, irrespective of whether they are currently active or currently assigned to the county. These same issues arise for referral reporting related to agency and district managers.

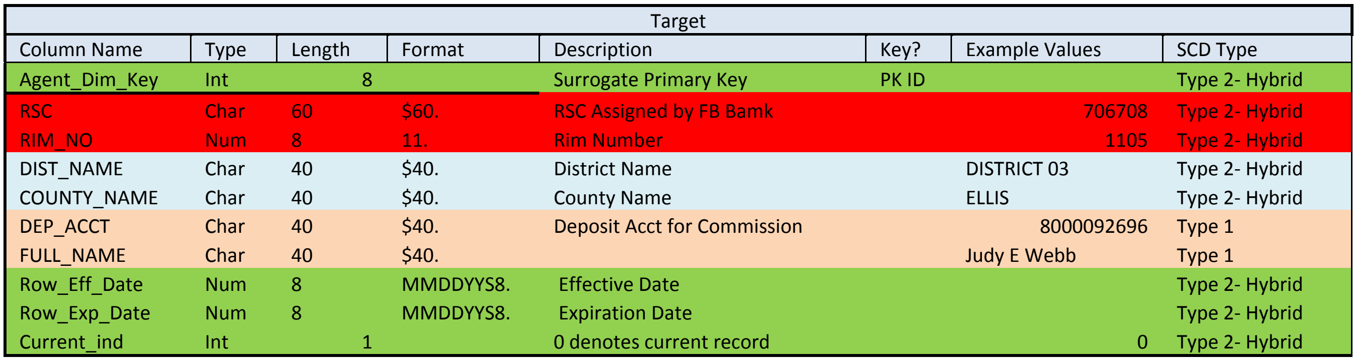
To handle these requirements a data warehouse was developed with an application fact table and a number of different dimensions including an agent dimension. The agent dimension is a type 2 slowly changing dimension that allows for tracking any changes in the agent status and reporting relationship. This allows us the flexibility necessary for providing the various reports that may be requested. To reduce processing time and provide the functionality needed to maintain the agent dimension a SAS hash object was used. Reports are produced using SAS BI tools including OLAP cubes and Web Report Studio.

DATA WAREHOUSE

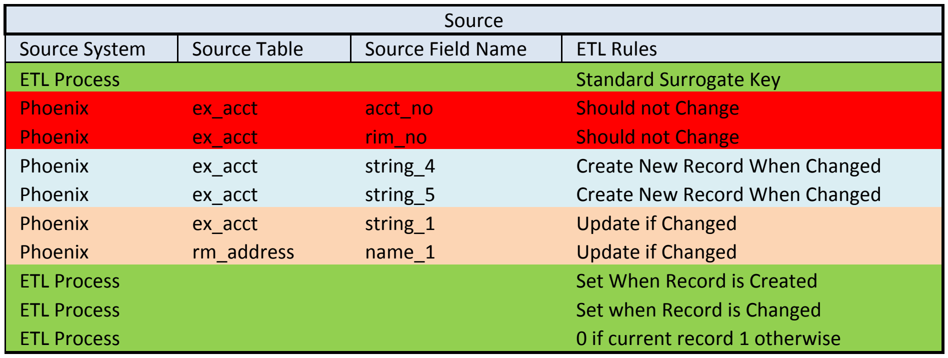
In building our data warehouse we use the basic ETL process. We extract application data from the various databases and input channels, transform and clean the data to conform to bank and regulatory standards then load the information into our Application fact table and assorted dimension tables.

AGENT ROSTER – A SLOWLY CHANGING DIMENSION

The key to being able to produce the desired reports is the Agent Roster table. This table is structured as a slowly changing dimension. This allows us to track changes in the agent location or reporting structure. Below is an example of the type of information stored in our agent dimension table. This is only a subset of the demographic and internal/external account data we track. For demonstration purposes we will use this small dataset to walk you through the Agent Dimension updating process.



Target							
Column Name	Type	Length	Format	Description	Key?	Example Values	SCD Type
Agent_Dim_Key	Int	8		Surrogate Primary Key	PK ID		Type 2- Hybrid
RSC	Char	60	$60.	RSC Assigned by FB Bamk		706708	Type 2- Hybrid
RIM_NO	Num	8	11.	Rim Number		1105	Type 2- Hybrid
DIST_NAME	Char	40	$40.	District Name		DISTRICT 03	Type 2- Hybrid
COUNTY_NAME	Char	40	$40.	County Name		ELLIS	Type 2- Hybrid
DEP_ACCT	Char	40	$40.	Deposit Acct for Commission		8000092696	Type 1
FULL_NAME	Char	40	$40.			Judy E Webb	Type 1
Row_Eff_Date	Num	8	MMDDYYS8.	Effective Date			Type 2- Hybrid
Row_Exp_Date	Num	8	MMDDYYS8.	Expiration Date			Type 2- Hybrid
Current_ind	Int	1		0 denotes current record		0	Type 2- Hybrid



Source			
Source System	Source Table	Source Field Name	ETL Rules
ETL Process			Standard Surrogate Key
Phoenix	ex_acct	acct_no	Should not Change
Phoenix	ex_acct	rim_no	Should not Change
Phoenix	ex_acct	string_4	Create New Record When Changed
Phoenix	ex_acct	string_5	Create New Record When Changed
Phoenix	ex_acct	string_1	Update if Changed
Phoenix	rm_address	name_1	Update if Changed
ETL Process			Set When Record is Created
ETL Process			Set when Record is Changed
ETL Process			0 if current record 1 otherwise

Figure 1. Agent Dimension Table Structure

The starting point in the creation of all of our dimension and fact tables is good documentation. Above is a Target/Source table for our Agent Roster dimension table. It gives some of the basic column properties of the dataset as well as details specific to the ETL process. For example, SCD Type provides information on the type of slowly changing dimension for each variable. We also store information on the database and table(s) our source data is coming from as well as rules about how each variable is updated or replaced. Having these tables as a starting point in our data warehouse design has saved countless hours during the creation and debugging of our ETL programs. (RSC is the referral source code which is a unique identifier assigned by the bank to referring agents).

STEP 1: CREATING WORK TABLES WITH AGENT_ROSTER AND UPDATE TABLES

The first steps in the program copy the Agent_Roster from the permanent library into the work library and pull data from the banking system to create the roster update table (Agent_Roster_UPD)   in the work library. You will notice that in the Agent_Roster_UPD program we rename some of the variables by adding a T_ to the beginning. This is done in order to facilitate comparison of fields in the current Agent_Roster to the Agent_Roster update table (step 3). We have highlighted the differences between the current and update tables.

We track any changes or new agents with a change log table. Reports are created using this table to allow other bank departments to verify that any changes they have made to the agent record in the banking system have been entered correctly. Any changes to the records in the agent table, either a new record or a changed record, are tracked in the change log file.

Agent_Roster								
RSC	RIM_NO	FULL_NAME	DEP_ACCT	DIST_NAME	COUNTY_NAME	RIM_RSC	Current_Ind	Agent_Dim_Key
700001	100001	Ken Arrow	500001	District 1	Keynes	1000017000010	0	100
700002	100002	Anna Schwartz	500002	District 1	Keynes	1000027000020	0	101
700003	100003	Frank Edgeworth	500003	District 1	Keynes	1000037000030	0	102
700004	100004	Irving Fisher	500004	District 1	Keynes	1000047000040	0	103
700005	100005	Bill Phillips	500005	District 1	Friedman	1000057000050	0	104
700006	100006	Gene Slutsky	500006	District 1	Friedman	1000067000060	0	105
700007	100007	Fritz Pareto	500007	District 1	Friedman	1000077000070	0	106

Figure 2. Agent Roster Table Before Updating

```
proc sql;
   create table Agent_Roster_UPD as
   select rsc,
          rim_no,
          full_name as T_full_name,             1
          dep_acct as T_dep_acct,
          dist_name as T_dist_name,
          county_name as T_county_name
   from (Banking System);
quit;

data Agent_Roster_UPD;
set Agent_Roster_UPD;          2
length  rim_rsc $15.;
rim_rsc=cats(rim_no,rsc,'0');
run;
```

1. Pull the fields from the banking system and change the names as needed.
2. Create a unique variable rim_rsc based upon the RIM and RSC fields; a ‘0’ is appended to the field which indicates a current record.

Agent_Roster_UPD						
RSC	RIM_NO	T_FULL_NAME	T_DEP_ACCT	T_DIST_NAME	T_COUNTY_NAME	rim_rsc
700001	100001	Ken Arrow	500001	District 1	Friedman	1000017000010
700002	100002	Anna Schwartz	500002	District 1	Keynes	1000027000020
700003	100003	Frank Edgeworth	500003	District 1	Keynes	1000037000030
700004	100004	Irving Fisher	500004	District 1	Keynes	1000047000040
700005	100005	Bill Phillips	600001	District 1	Friedman	1000057000050
700006	100006	Gene Slutsky	500006	District 1	Friedman	1000067000060
700007	100007	Fritz Pareto	500007	District 1	Friedman	1000077000070
700008	100008	Fischer Black	600000	District 1	Friedman	1000087000080

Figure 3. Agent Roster UPD Table with Differences Highlighted

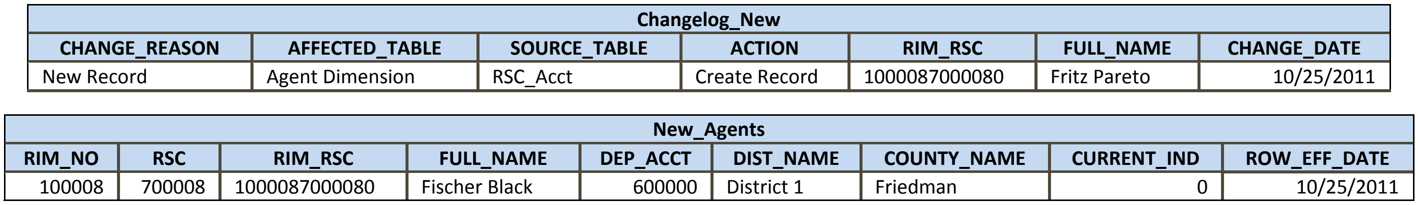
STEP 2: ADDING A NEW RECORD INTO THE AGENT DIMENSION USING A HASH TABLE

The first task in keeping the Agent dimension up to date is to check for new agents. A table (Agent_Roster_UPD) containing all of the current agents and their information is pulled from the banking system. The Agent_Roster table is then is loaded as a hash table and the Agent_Roster_UPD table is checked against this table using the Rim_RSC as the key. If the Rim_RSC is not found in the Agent_Roster then a record is created in the table New_Agents and a record is created in the change log with the information about the new record. The record is then added into the Agent_Roster table.

```
data work.Changelog_New(keep= full_name affected_table source_table change_date
change_reason rim_rsc change_date)
work.New_Agents (keep=rim_rsc);
length  change_reason table_name $40. affected_table source_table action $15.;
       if 0 then set WORK.Agent_Roster;
       format change_date mmddyy8.;                                   1
       if _n_ =1 then do;
declare hash rimhash(DATASET:'WORK.Agent_Roster', ORDERED:'A',HASHEXP:16
       rc=rimhash.defineKey('rim_rsc');
       rc=rimhash.defineData( 'rim_rsc', 'full_name');
       rc=rimhash.defineDone();
  end;
       affected_table 'Agent Dimension';
       change_date=date();
       change_date='Create Record';
       source_table='RSC_Acct';
       full_name='';
       do while (not done);
             set WORK.Agent_Roster_UPD  end=done;
             rc=rimhash.find() ;
             if rc ne 0 then do;                                 2
                    change_reason='New Record';
                    output work.Changelog_New;
                 output work.New_Agents;
             end;
       end;
stop;
run;
```

3. Define the hash table, the key and the data desired to be returned from the table

4. Check to see if the records in the Agent_Roster_UPD are in the agent_roster table. If not, create a new record and put a notation in the change log.



Changelog_New						
CHANGE_REASON	AFFECTED_TABLE	SOURCE_TABLE	ACTION	RIM_RSC	FULL_NAME	CHANGE_DATE
New Record	Agent Dimension	RSC_Acct	Create Record	1000087000080	Fritz Pareto	10/25/2011

New_Agents								
RIM_NO	RSC	RIM_RSC	FULL_NAME	DEP_ACCT	DIST_NAME	COUNTY_NAME	CURRENT_IND	ROW_EFF_DATE
100008	700008	1000087000080	Fischer Black	600000	District 1	Friedman	0	10/25/2011

Figure 4. Records Created in Changelog_New and New_Agent tables

STEP 3: CHECKING FOR CHANGED INFORMATION USING A HASH TABLE - OVERWRITE

The next step is to check if any of the fields in the agent table have been changed since the last update of the agent record. Some of the fields result in new records being created (Step 4) if they are different, and other fields are overwritten. Based on the Target/Source table we know that the full_name and dep_acct variables are Type 1. This means that if a change is detected in either of these variables, the fields are overwritten with the new data. Shown below is the code that is used to update the records for fields that are overwritten. (For brevity we have included only the Dep_Acct variable)

```
data work.Changelog_Overwrite (keep=rim_no rsc full_name affected_table source_table
change_date orig_char new_char change_rsn state rim_rsc action) ;
length orig_char new_char change_rsn $40. affected_table source_table action $15.;
       format change_date mmddyy8.;
       if 0 then set work.Agent_Roster;
       if _n_ =1 then do;
```

```
        declare hash rimhash(DATASET:'work.Agent_Roster', ORDERED:'A');
        rc=rimhash.defineKey('rim_rsc');
rc=rimhash.defineData(‘rim_rsc’,'rsc','rim_no','full_name','dist_name','county_name','
dep_acct','current_ind');
        rc=rimhash.defineDone();
        end;
        affected_table='Agent Dimension';
        Change_date=date();                                           1
        Source_table='RM_ACCT';
        action='Update Record';
do while (not done1);
        set work.Agent_Roster_UPD  end=done1;
        rc=rimhash.find() ;
        if rc = 0 then do;
                if T_dep_acct ne dep_acct then do;
                        orig_char=strip(dep_acct);
                        new_char=strip(T_dep_acct);                     2
                        change_rsn='change in dep_acct';
                        output work.Changelog_Overwrite;
                        dep_acct=T_dep_acct;
                end;
                RC=rimhash.replace();
        end;
end;
rc=rimhash.output(dataset:'Agent_Roster2'); /* need to output hash table*/
stop;
run;
```

1. This data is used to track the change information that is entered into the change log
2. This will replace the any changed fields with the updated fields.

Changelog_Overwrite										
ORIG_CHAR	NEW_CHAR	CHANGE_RSN	AFFECTED_TABLE	SOURCE_TABLE	ACTION	FULL_NAME	RIM_NO	RSC	RIM_RSC	CHANGE_DATE
500005	600001	change in DEP_ACCT	Agent Dimension	RM_ACCT	Update Record	Bill Phillips	100005	700005	1000057000050	10/25/2011

Agent_Roster2							
RIM_RSC	RSC	RIM_NO	FULL_NAME	DIST_NAME	COUNTY_NAME	DEP_ACCT	CURRENT_IND
1000017000010	700001	100001	Ken Arrow	District 1	Keynes	500001	0
1000027000020	700002	100002	Anna Schwartz	District 1	Keynes	500002	0
1000037000030	700003	100003	Frank Edgeworth	District 1	Keynes	500003	0
1000047000040	700004	100004	Irving Fisher	District 1	Keynes	500004	0
1000057000050	700005	100005	Bill Phillips	District 1	Friedman	600001	0
1000067000060	700006	100006	Gene Slutsky	District 1	Friedman	500006	0
1000077000070	700007	100007	Fritz Pareto	District 1	Friedman	500007	0

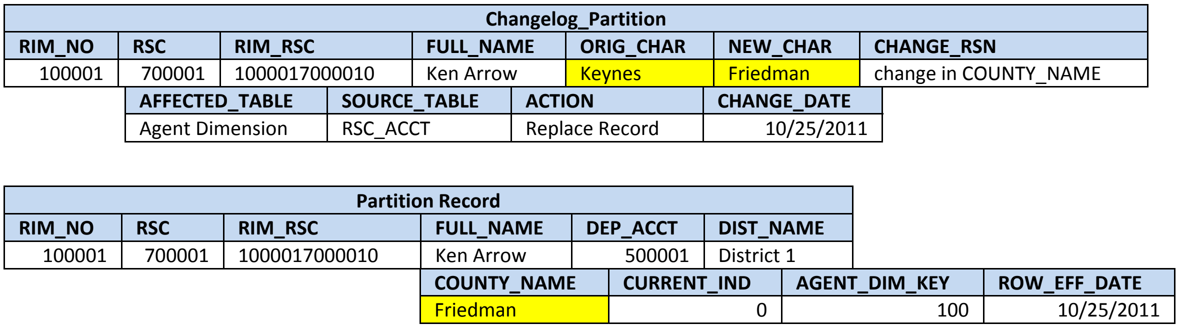
Figure 5. Changelog_Overwrite and Agent_Roster2 tables

STEP 4: CHECKING FOR CHANGED INFORMATION USING A HASH TABLE – PARTITION

The next step is to check if any of the fields that would result in a new agent record being created have been changed since the last update of the agent record. This step shows the code used to partition Type 2 variables. Whenever there is a change in these variables a new record is created in a temporary table and will be added to the dimension table in Step 6.

```
data WORK.Changelog_Partition (keep=rim_no rsc full_name affected_table source_table
change_date orig_char new_char change_rsn state rim_rsc action)
WORK.Partition_Rec (keep=rsc rim_no full_name city dist_name county_name dep_acct
row_eff_date row_exp_Date current_ind rim_rsc agent_dim_key);
        if 0 then set work.Agent_Roster2;
```

```
       length orig_char orig_char new_char change_rsn table_name $40. affected_table
       source_table action $15.;
       format change_date mmddyy8.;
       if _n_ =1 then do;
              declare hash rimhash(DATASET:'work.Agent_Roster2', ORDERED:'A');
       rc=rimhash.defineKey('rim_rsc');
       rc=rimhash.defineData('rim_rsc','rsc','rim_no','full_name','dist_name','county_
       name', 'dep_acct','agent_aim_key');
              rc=rimhash.defineDone();
         end;
affected_Table='Agent Dimension';
change_date=date();
action='Replace Record';
source_table='RSC_ACCT';
       do while (not done);
       set WORK.Agent_Roster_UPD  end=done;
       rc=rimhash.find() ;
       replace=0;
       if rc = 0 then do;
              if T_county_name ne county_name then do;
                     orig_char= county_name;
                     New_char=T_ county_name;
                     change_rsn='change in county_name';
                     output work.changelog_Partition;
                     replace=1;
                     county_name=T_COUNTY_NAME;
              end;
              if replace =1 then do;
                     row_eff_date=Today();
                     current_ind=0;
                     output work.Partition_rec;
              end;
       end;
end;
stop;
run;
```



Changelog_Partition

RIM_NO	RSC	RIM_RSC	FULL_NAME	ORIG_CHAR	NEW_CHAR	CHANGE_RSN	AFFECTED_TABLE	SOURCE_TABLE	ACTION	CHANGE_DATE
100001	700001	1000017000010	Ken Arrow	Keynes	Friedman	change in COUNTY_NAME	Agent Dimension	RSC_ACCT	Replace Record	10/25/2011

Partition Record

RIM_NO	RSC	RIM_RSC	FULL_NAME	DEP_ACCT	DIST_NAME	COUNTY_NAME	CURRENT_IND	AGENT_DIM_KEY	ROW_EFF_DATE
100001	700001	1000017000010	Ken Arrow	500001	District 1	Friedman	0	100	10/25/2011

Figure 6. Change Log and Partition Record

STEP 5: ADVANCING CURRENT INDICATOR FOR PARTITIONED RECORDS

In this step the current indicator is incremented for any agent records for which a changed field causes a new record to be created. The variable current_ind is used to track changes in an Agent's record. If current_ind = 0 then this is the most recent record. Therefore it is necessary to advance the current indicator for all entries related to the partitioned records. We also add a row expiration date variable in order to have a record of when the information in a partitioned entry was changed.

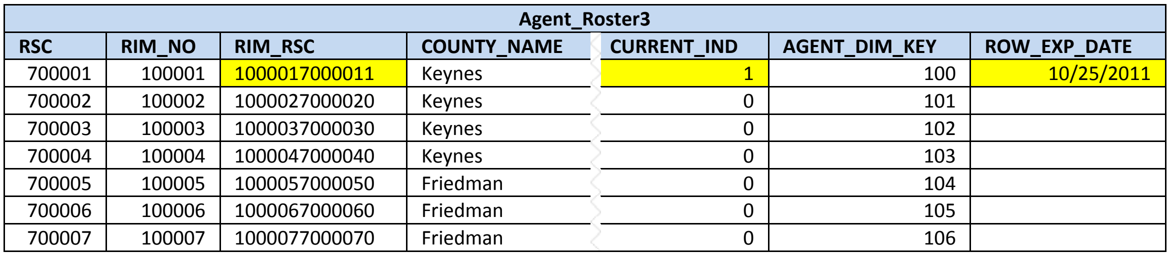
```
data work.partition;
set work.changelog_partition (keep= rim_no rsc);
run;
```

```
proc sort data=WORK.Agent_Roster2; by rim_no rsc;run;
proc sort data=work.partition nodupkey; by rim_no rsc;run;

data work. Agent_Roster3;
merge work.partition (in=a) WORK.Agent_Roster2 (in = b);
       by rim_no rsc;
       if a and b then do;
              if current_ind=0 then row_exp_date=today()-1;
              Current_ind=Current_ind+1 ;
              rim_rsc=cats(rim_no,rsc,current_ind);
       end;
run;
```

1

1. This will update the current indicator by 1 for any record that will be replaced. It also adds the current indicator to the Rim_RSC, keeping that field as a unique field.



Agent_Roster3						
RSC	RIM_NO	RIM_RSC	COUNTY_NAME	CURRENT_IND	AGENT_DIM_KEY	ROW_EXP_DATE
700001	100001	1000017000011	Keynes	1	100	10/25/2011
700002	100002	1000027000020	Keynes	0	101	
700003	100003	1000037000030	Keynes	0	102	
700004	100004	1000047000040	Keynes	0	103	
700005	100005	1000057000050	Friedman	0	104	
700006	100006	1000067000060	Friedman	0	105	
700007	100007	1000077000070	Friedman	0	106	

Figure 7. Agent_Roster3 Table

STEP 6: CREATING NEW AGENT KEY FOR NEW RECORDS

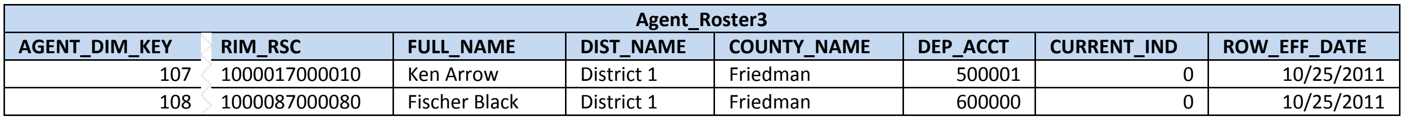
In this next to last step of the Agent Dimension update process we are adding the Agent Keys to any new records in the dimension table. The highlighted section shows the hash method used to find the last key in the dataset. Once this is located the Keycount is advanced by 1 for all new and partitioned entries.

```
data work.New_Partitioned (drop = Keycount rc);
Length Agent_Dim_Key 8.;
/*******************  Hash Object to Get Last foreign Key  ***********************/
       retain Keycount;
       if _n_ =1 then do;
              declare hash for_key(DATASET:'WORK.Agent_Roster3', ORDERED:'A');
       rc=for_key.defineKey('Agent_Dim_Key');
              rc=for_key.defineData('Agent_Dim_Key');
              declare hiter hi_for_key('for_key');
              rc=for_key.defineDone();
              rc=hi_for_key.last();   /* Get last key in the table  */
              Keycount=Agent_Dim_Key;
       end;
/*******************  End of Hash Object to Get Last foreign Key
***********************/

set  work.partition_rec work.New_Agents;
Keycount=keycount+1;
Agent_Dim_Key=keycount;
run;
```

1

1. Set up the iterative hash table to determine the last key in the current table.



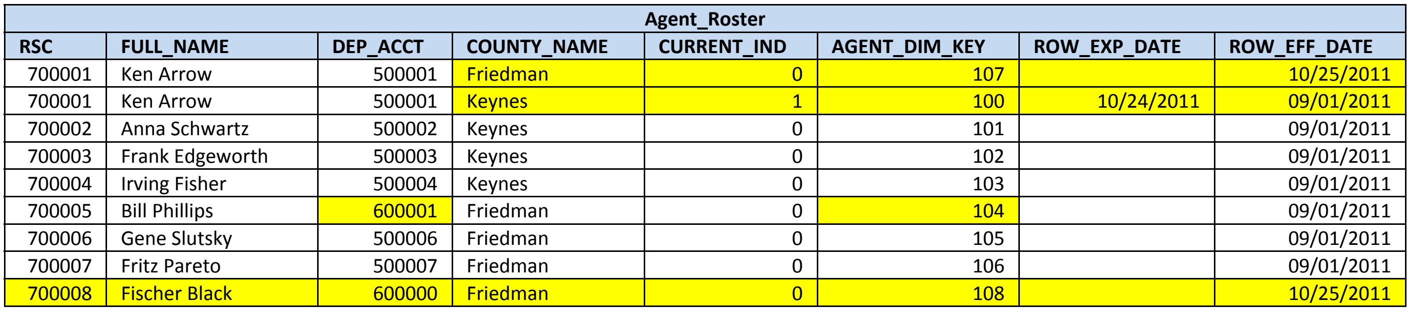
Agent_Roster3							
AGENT_DIM_KEY	RIM_RSC	FULL_NAME	DIST_NAME	COUNTY_NAME	DEP_ACCT	CURRENT_IND	ROW_EFF_DATE
107	1000017000010	Ken Arrow	District 1	Friedman	500001	0	10/25/2011
108	1000087000080	Fischer Black	District 1	Friedman	600000	0	10/25/2011

Figure 8. Agent_Roster3 Table

STEP 7: CREATING NEW AGENT_ROSTER TABLE

The final step adds the new and partitioned records with the updated key and the rim_rsc to the full dataset and our Agent Roster dimension table has been updated. The highlighted cells show the data and/or records that have been overwritten or partitioned.

```
data dataware_Agent_Roster;
set work.Agent_Roster3 work.New_Partitioned;
format row_eff_date row_exp_date mmddyy8.;
by rsc  current_ind;
run;
```

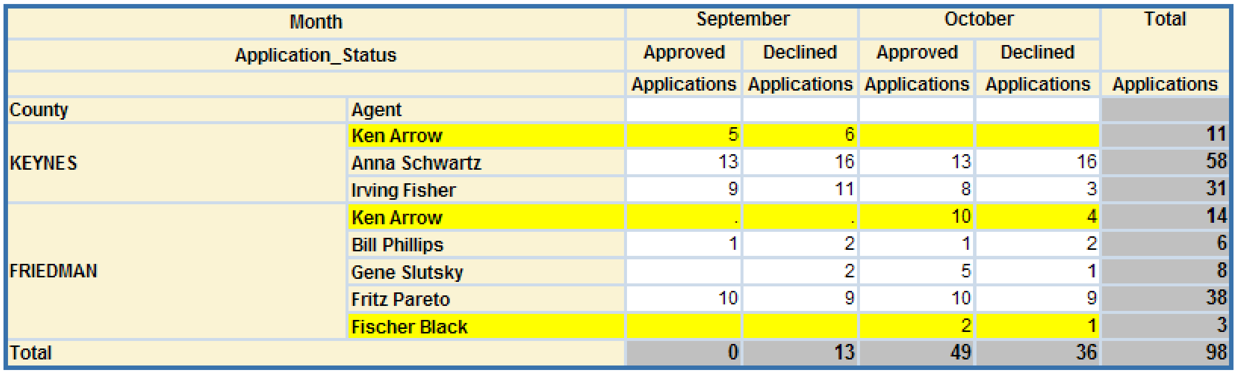


Agent_Roster							
RSC	FULL_NAME	DEP_ACCT	COUNTY_NAME	CURRENT_IND	AGENT_DIM_KEY	ROW_EXP_DATE	ROW_EFF_DATE
700001	Ken Arrow	500001	Friedman	0	107		10/25/2011
700001	Ken Arrow	500001	Keynes	1	100	10/24/2011	09/01/2011
700002	Anna Schwartz	500002	Keynes	0	101		09/01/2011
700003	Frank Edgeworth	500003	Keynes	0	102		09/01/2011
700004	Irving Fisher	500004	Keynes	0	103		09/01/2011
700005	Bill Phillips	600001	Friedman	0	104		09/01/2011
700006	Gene Slutsky	500006	Friedman	0	105		09/01/2011
700007	Fritz Pareto	500007	Friedman	0	106		09/01/2011
700008	Fischer Black	600000	Friedman	0	108		10/25/2011

Figure 9. Agent roster table with changed and new records

STEP 8: BI REPORTING

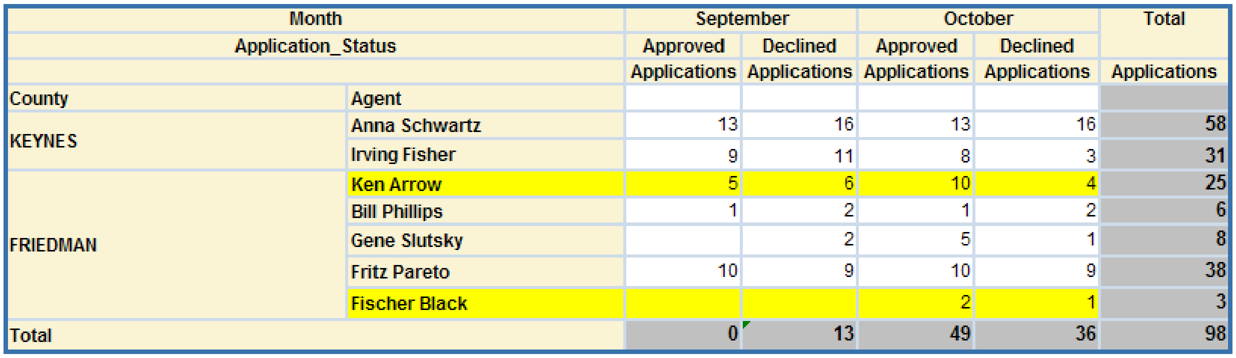
The agent dimension is used with the application fact table to create an OLAP cube for reporting. A referred application will have an RSC associated with it and this is used to establish the link with the application dimension and the agent dimension key. Once the link between the application fact table and the agent dimension, it is simple to create the reports desired. AN OLAP cube is created with dimension that allows drilling down from state to county to agent. With the link between the fact table and the agent based upon the location at the time of the application, reports will show multiple locations for the agents based upon their location at time of the application. An example of this report is shown below. In addition any new agents and their applications will be shown.



Month		September		October		Total
Application_Status		Approved	Declined	Approved	Declined	
		Applications	Applications	Applications	Applications	Applications
County	Agent					
KEYNES	Ken Arrow	5	6			11
	Anna Schwartz	13	16	13	16	58
	Irving Fisher	9	11	8	3	31
FRIEDMAN	Ken Arrow	.	.	10	4	14
	Bill Phillips	1	2	1	2	6
	Gene Slutsky		2	5	1	8
	Fritz Pareto	10	9	10	9	38
	Fischer Black			2	1	3
Total		0	13	49	36	98

Figure 10. Application Report based upon location of agent at time of application

A report can also be created based upon the current location of the agent irrespective of the location of the agent at the time of the application. Selecting all of the applications of the agent and then basing the agent location on the current location of the agent results in the creation of this report.



Month		September		October		Total
Application_Status		Approved	Declined	Approved	Declined	
		Applications	Applications	Applications	Applications	Applications
County	Agent					
KEYNES	Anna Schwartz	13	16	13	16	58
	Irving Fisher	9	11	8	3	31
FRIEDMAN	Ken Arrow	5	6	10	4	25
	Bill Phillips	1	2	1	2	6
	Gene Slutsky		2	5	1	8
	Fritz Pareto	10	9	10	9	38
	Fischer Black			2	1	3
Total		0	13	49	36	98

Figure 11. Application Report based upon current location of agent

CONCLUSION

The hash tables make it possible to easily check for any changes in fields and determine the last key in a current table. Because the hash tables are in memory, the hash tables also result in decreased processing time. Structuring the agent dimension table with the type 1 and type 2 variables provides the ability to easily create the desired reports. Reports created from the change log table provide other departments of the bank with information concerning new and changed records resulting in easy validation of any changes.

REFERENCES

- Dorfman, Paul. “Data Step Hash Objects as Programming Tools” Proceeding of SUGI 30
- Dorfman Paul and Vyverman, Koen. “The SAS® Hash Object in Action” Proceedings of the SAS Global Forum 2009
- Eberhardt, Peter. 2010 “The SAS® Hash Object: It’s Time to .find() Your Way Around” Proceedings of the SAS Global Forum 2010
- Kimball, Ralph and Ross, Margy. 2002. *The Data Warehouse Toolkit, 2nd Ed.* New York, New York. Wiley Computer Publishing
- Kimball, Ralph and Caserta, Joe. 2004. *The Data Warehouse ETL Toolkit.* New York, New York. Wiley Computer Publishing
- Loren, Judy. 2008. “How Do I Love Hash Tables: Let Me Count the Ways!” Proceedings of the SAS Global Forum 2008

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