FUNCTIONAL DESIGN DOCUMENT

BI-TEMPORAL HISTORIZATION DATA MODEL

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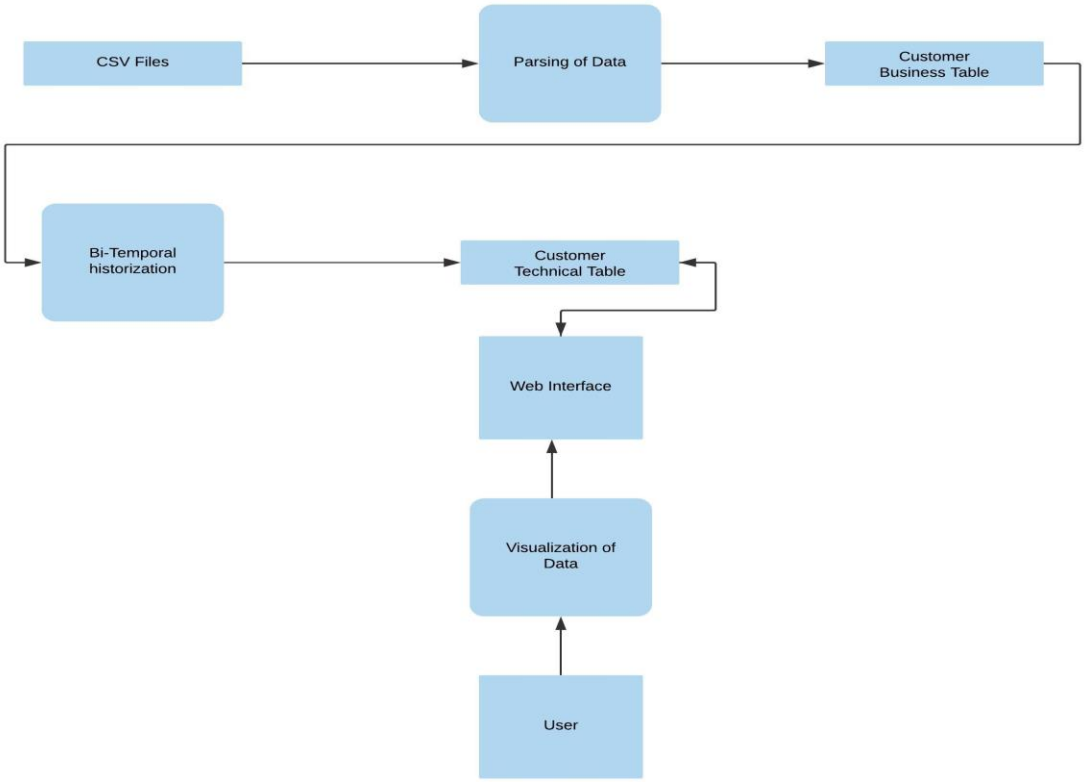
1. Scope of the project

The Project deals with the implementation of a Bi-Temporal Historization model based on SAP HANA Database which should be able to handle the insert, update, correction and deletion of data records. The data records in the CSV files will be loaded on daily basis to the HANA Database so that a bi-temporal model is established so that the business end user can perform and see the relevant sequence of changes/updates happened to the data records over time. The Business user should be able to identify if a specific data record is valid and active or not at a particular instance of time. The Business user should be also able to perform corrections in the data records when he realizes that the data records on a past particular date is invalid and needs to be corrected.

2. Design

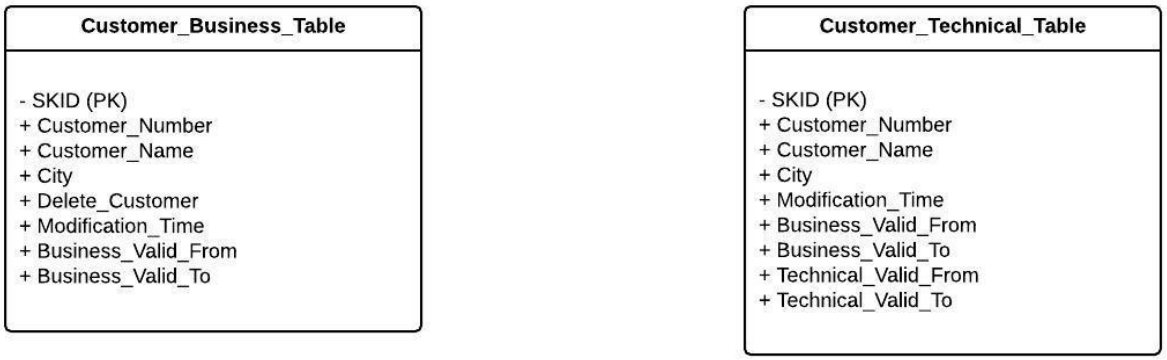
2.1 Data Flow Diagram



- The CSV files will have the customer records and each customer record is supposed to have a customer number, customer name, city and validity period which specifies the time when the customer resided in a particular city.
- The CSV files are uploaded to the Customer Business Table on a daily basis by scheduling a Job at a particular time daily without losing its semantics.
- Subsequently, the customer records are expected to get reflected in the Customer Business Table in the HANA DB.
- The Customer Business Table will have the customer records with respect to one time dimension, ‘Business Valid From’ and ‘Business Valid To’.
- Several Store procedures are implemented so that a Bi-Temporal Historization Model is established on the Customer Technical Table. The Bi-Temporal Historization Model maps the customer records of the Customer Business Table in one time dimension to that of Customer Technical Table in two time dimensions.

- The Customer Technical Table will have the customer records with respect to two time dimensions; that is, Business Valid From, Business Valid To, Technical Valid From and Technical Valid To.
- The Customer Technical Table needs to keep track of and handles all the insert operations of new records, update operations on the existing records (new update event), correction operations on existing records (past forgotten event being updated now) and delete operations on existing customer records.
- The Customer Technical Table which follows the Bi-Temporal Historization is available for view to the users via a Web Application which will be realized using SAP UI5 Web Application.
- Users will have the opportunity to visualize the updates happened on the customer records over time, the current active status of a specific customer and the status of a customer on a particular past date.

2.2 Logical Data Model (Conceptual Model)



We propose to use two tables

1. Customer Business Table with one time dimension: Business Validity period.
2. Customer Technical Table with two time dimensions: Business Validity period and Technical Validity period.

As both the tables stores the customer information, both the tables shares a common set of columns as follows:

- SKID: Surrogate Key which acts as the auto increment primary key for both tables with private access modifier.
- Customer_Number : A Unique Number for each customer with public access modifier.
- Customer_Name : stores the name of each customer as public.

- City: stores the residential city of each customer as public.
- Deletion_Customer : Deletion flag to inactivate the customer with respect to death event with public access.
- Modification_Time: to handle the instantaneous time when each operations are carried out in the database with public access.
- Business_Valid_From : Date field from which a record becomes valid with respect to the business context with public access.
- Business_Valid_To : Date field up to which a record is valid with respect to the business context with public access.

- Furthermore, As the Customer Technical Tables keeps track of the changing records with respect to two time dimensions; the customer Technical table, in addition to business validity period should have the following additional time fields.
- Technical_Valid_From: Date field from which a record becomes valid with respect to the technical context with public access.
- Business_Valid_To : Date field up to which a record is valid with respect to the technical context with public access.

2.3 Physical Data Model

Customer_Business_Table		
SKID_Auto	bigint	PK
Customer_Number	varchar(10)	N
Customer_Name	varchar(20)	N
City	varchar(35)	N
Delete_Customer	boolean	N
Modification_Time	timestamp	N
Business_Valid_From	date	N
Business_Valid_To	date	

Customer_Technical_Table		
SKID_Auto	bigint	PK
Customer_Number	varchar(10)	N
Customer_Name	varchar(20)	N
City	varchar(35)	N
Delete_Customer	boolean	N
Modification_Time	timestamp	N
Business_Valid_From	date	N
Business_Valid_To	date	
Technical_Valid_From	date	N
Technical_Valid_To	date	

The Physical Data Model specifies further the assigned data types to each column of the two tables and also, the other integrity constraints like the primary key fields and NOT NULL criteria.

- SKID key is assigned as the auto-increment primary key for both the tables and hence, obviously cannot be NULL and is assigned with the data type ‘BIGINT’.
- Customer_Number is assigned with the data type ‘NVARCHAR’ which accommodates a length of 10 characters and must be ‘NOT NULL’
- Customer_Name is assigned with the data type ‘NVARCHAR’ which accommodates a length of 20 characters and must be ‘NOT NULL’.
- City is assigned with the data type ‘NVARCHAR’ which accommodates a length of 35 characters and must be ‘NOT NULL’.
- Delete_Customer is assigned with the data type ‘BOOLEAN’ which can be set as either ‘TRUE’ or ‘FALSE’ and must be ‘NOT NULL’.
- Modification_Time is assigned with the data type ‘TIMESTAMP’ to stamp the instantaneous time of operations done on the DB and hence, must be ‘NOT NULL’.
- Business_Valid_From is assigned with the data type ‘DATE’ and must be ‘NOT NULL’.
- Business_Valid_To is assigned with the data type ‘DATE’ .

As specified earlier, the above columns are common for both the tables. The Customer Technical table which follows the Bi-temporal Model have two more technical date fields which must be also assigned with specific data types and integrity constraints.

- Technical_Valid_From is assigned with the data type ‘DATE’ and must be ‘NOT NULL’.
- Technical_Valid_To is assigned with the data type ‘DATE’.

Following the above functional specifications of the data models, The respective Customer Business Table and Customer Technical Tables is to be implemented on the HANA Database.

3. Development Considerations

- Based on the Logical Data Model and Physical Data Model defined, The Customer Business Table and Customer Technical Table is developed and implemented on the HANA Database.

- The Customer records in the CSV files must be loaded into the Customer Business Table via a scheduled Job on a daily basis.

- Hence, the customer records in the Customer Business Table must be stored with respect to one time dimension, the Business Validity period. Therefore, the Customer Business Table will have two date fields namely ‘Business Valid From’ and ‘Business Valid To’.

- The Customer Business Table is expected to encounter the following use cases from the daily CSV uploads scheduled through the Job.
    - Insertion of new customer records
    - New updation of existing customer records
    - Correction of existing customer records, updation of a past missed event now.
    - Deletion of existing customer records.

- With regards to each of the above use cases, the Customer Technical Tables is expected to close the existing record and insert new records based on the respective use cases ensuring that all the changes that happened over time to each customer record is registered without fail.

- Store procedures are developed to handle the effects on Customer Technical table for each respective operation on the Customer Business Table.

- Insert Use Case: When a new customer record is inserted on the Customer Business Table with a specific ‘Business Valid From’ date. Consequently, a new corresponding customer record is inserted in the Customer Technical Table with the ‘Business Valid From’ date as the ‘given date’, ‘Business Valid To’ as ‘ open (infinity) ‘, ‘Technical Valid From’ as ‘modification time’ and ‘Technical Valid To’ as ‘Open/Infinity’. As a result, an active customer record must have their ‘Business Valid To’ and ‘Technical Valid To’ date fields as ‘Open/Infinity’.

Customer_Business Table

Customer_Number	Customer_Name	City	Delete_Customer	Business_valid_from	Business_valid_to
1	John Doe	Small Ville	False	06-06-1995	31-12-9999

Customer_Technical Table

Customer_Number	Customer_Name	City	Business_valid_from	Business_valid_to	Technical_from	Technical_to
1	John Doe	Small Ville	06-06-1995	31-12-9999	14-12-2018	31-12-9999

*Execution Date: 14.12.2018

- Update Use Case (A Current City Change): When a existing customer record is modified on the Customer Business Table with a new ‘City’ valid from a new ‘Business Valid From’ date. Subsequently, three events happen at the Customer Technical Table.
    - ‘Technical Valid To’ of the existing customer record becomes closed with the date of execution.
    - A New record of the same customer with the same city gets inserted with ‘Business Valid From’ as the old ‘Business Valid From’ date, ’‘Business Valid To’ as closed with the new ‘Business Valid from’ date, ‘Technical Valid from’ as the ‘modified date’, and ‘Technical Valid To’ as ‘Open/Infinity’.
    - A New record of the same customer with the new city gets inserted with ‘Business Valid From’ as the new ‘Business Valid From’ date, ’‘Business Valid To’ as ‘Open’, ‘Technical Valid from’ as the ‘modified date’, and ‘Technical Valid To’ as ‘Open/Infinity’.

Customer_Business Table

Customer_Number	Customer_Name	City	Delete_Customer	Business_valid_from	Business_valid_to
1	John Doe	Beachy	False	06-06-2000	31-12-9999

Customer_Technical Table

Customer_Number	Customer_Name	City	Business_valid_from	Business_valid_to	Technical_from	Technical_to
1	John Doe	Small Ville	06-06-1995	31-12-9999	14-12-2018	15-12-2018
1	John Doe	Small Ville	06-06-1995	06-06-2000	15-12-2018	31-12-9999
1	John Doe	Beachy	06-06-2000	31-12-9999	15-12-2018	31-12-9999

*Execution Date: 15.12.2018

- Correction Use Case (Past City Change which was never reported and is reported now): When a existing customer record is modified on the Customer Business Table with a new ‘City’ , valid from a old ‘Business Valid From’ date and valid upto a old ‘Business Valid To’ which was never reported then and is reported now. Subsequently, three records of the same customer gets inserted at the Customer Technical Table.
    - A New record of the customer with the ‘Old City’, with ‘Business Valid From’ as the old date, ‘Business Valid To ’ as the new Business Valid From of the customer Business Table, ‘Technical Valid From’ as the modified date, ‘Technical Valid To’ as Open.
    - A New record of the same customer with the New city gets inserted with ‘Business Valid From’ as the new ‘Business Valid From’ of the customer Business Table, ’Business Valid To’ as the new Business Valid To of the customer Business Table , ‘Technical Valid from’ as the ‘modified date’, and ‘Technical Valid To’ as ‘Open/Infinity’.
    - A New record of the same customer with the Old city gets inserted with ‘Business Valid From’ as the new ‘Business Valid To date of the customer Business table , ‘Business Valid To’ as the Business Valid To of the previous record, ‘Technical Valid from’ as the ‘modified date’ and ‘Technical Valid To’ as ‘Open/Infinity’.

Customer_Business Table

Customer_Number	Customer_Name	City	Delete_Customer	Business_valid_from	Business_valid_to
1	John Doe	Beachy	True	06-06-2000	06-06-2005

Customer_Technical Table

Customer_Number	Customer_Name	City	Business_valid_from	Business_valid_to	Technical_from	Technical_to
1	John Doe	Small Ville	06-06-1995	31-12-9999	14-12-2018	15-12-2018
1	John Doe	Small Ville	06-06-1995	06-06-2000	15-12-2018	16-12-2018
1	John Doe	Small Ville	06-06-1995	06-06-1997	16-12-2018	17-12-2018
1	John Doe	Big Town	06-06-1997	06-06-1998	16-12-2018	17-12-2018
1	John Doe	Small Ville	06-06-1998	06-06-2000	16-12-2018	17-12-2018
1	John Doe	Beachy	06-06-2000	31-12-9999	15-12-2018	17-12-2018
1	John Doe	Beachy	06-06-2000	06-06-2005	17-12-2018	17-12-2018

*Execution Date: 16.12.2018

- Deletion Use Case (A Current City Change): When an existing customer record is deleted on the Customer Business Table with deletion flag set as 'True' and explicit input of 'Business Valid To' date. Subsequently, two events happen at the Customer Technical Table.
    - 'Technical Valid To' of the existing customer record becomes closed with the modified date.
    - A New record of the same customer with the same city gets inserted with 'Business Valid From' as the old 'Business Valid From' date, ''Business Valid To' as the new input of Business Valid To date, 'Technical Valid from' as the 'modified date', and 'Technical Valid To' as 'modified date'.

Customer_Business Table

Customer_Number	Customer_Name	City	Delete_Customer	Business_valid_from	Business_valid_to
1	John Doe	Beachy	True	06-06-2000	06-06-2005

Customer_Technical Table

Customer_Number	Customer_Name	City	Business_valid_from	Business_valid_to	Technical_from	Technical_to
1	John Doe	Small Ville	06-06-1995	31-12-9999	14-12-2018	15-12-2018
1	John Doe	Small Ville	06-06-1995	06-06-2000	15-12-2018	16-12-2018
1	John Doe	Small Ville	06-06-1995	06-06-1997	16-12-2018	17-12-2018
1	John Doe	Big Town	06-06-1997	06-06-1998	16-12-2018	17-12-2018
1	John Doe	Small Ville	06-06-1998	06-06-2000	16-12-2018	17-12-2018
1	John Doe	Beachy	06-06-2000	31-12-9999	15-12-2018	17-12-2018
1	John Doe	Beachy	06-06-2000	06-06-2005	17-12-2018	17-12-2018

*Execution date: 17.12.2018