**Business Contact Interaction Tracking System Logical Design**

**Relations**

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| **Employee** (userID, firstName, lastName, jobTitle, companyID)  **Primary Key** userID  **Foreign Key** companyID **references** Company (companyID) |
| **Contact** (userID, salutation, secretaryID, personalComments)  **Primary Key** userID  **Foreign Key** userID **references** Employee (userID)  **Foreign Key** secretaryID **references** Employee (userID) |
| **Subordinate** (subordinateID, managerID, companyID)  **Primary Key** subordinateID  **Foreign Key** subordinateID **references** Employee (userID)  **Foreign Key** managerID **references** Employee (userID)  **Foreign Key** (subordinateID, companyID) **references** Employee (userID, companyID)  **Foreign Key** (managerID, companyID) **references** Employee (userID, companyID) |
| **Address** (userID, addressType, streetAddress, city, state, zipCode)  **Primary Key** (userID, addressType)  **Foreign Key** userID **references** Employee (userID |
| **PhoneNumber** (userID, phoneNumberType, phoneNumber)  **Primary Key** (userID, phoneNumberType)  **Foreign Key** userID **references** Employee (userID) |
| **EmailAddress** (userID, emailAddressType, emailAddress)  **Primary Key** (userID, emailAddressType)  **Foreign Key** userID **references** Employee (userID) |
| **InteractionEvent** (eventID, interactionEventType, date, comments)  **Primary Key** eventID |
| **InteractionEventParticipation** (eventID, userID)  **Primary Key** (eventID, userID)  **Foreign Key** eventID **references** InteractionEvent (eventID)  **Foreign Key** userID **references** Employee (userID) |
| **Company** (companyID, companyName)  **Primary Key** companyID |

**Constraints**

In addition to the constraints specified in the conceptual design (data dictionary), every employee can have only one address of each address type, one phone number of each phone number type, and one email address of each email address type.

**Validation**

Normalization

First Normal Form (1NF)

Each relation is in 1NF, as, by inspection, each relation does not have multi-valued attributes or repeating groups of attributes.

Second Normal Form (2NF)

The relations Employee, Contact, Subordinate, InteractionEvent, and Company have simple primary keys, so these relations are automatically in 2NF. Likewise, the InteractionEventParticipation relation has no non-primary-key attributes, so it is also automatically in 2NF. Since a given employee can have multiple addresses but only one address of each address type, streetAddress, city, state, and zipCode are fully functionally dependent on the entire primary key of Address, (userID, addressType). By similar reasoning, phoneNumber is fully functionally dependent on (userID, phoneNumberType), and emailAddress is fully functionally dependent on (userID, emailAddressType). Consequently, the relations Address, PhoneNumber, and EmailAddress are in 2NF as well. Therefore, all relations are in 2NF.

Third Normal Form (3NF)

Since a relation needs at least two non-primary-key attributes to have a transitive dependency, the relations PhoneNumber, EmailAddress, InteractionEventParticipation, and Company are automatically in 3NF. By inspection, the relations Employee, Contact, Subordinate, Address, and InteractionEvent are in 3NF, because all non-primary-key attributes of each relation are directly functionally dependent on the primary key of the relation. Thus, all relations are in 3NF.

Boyce-Codd Normal Form (BCNF)

All relations are in BCNF, as, in each relation, the primary key is the only candidate key in the relation.

User Transactions

The interaction events associated with a particular contact

The details of each interaction event are held in the InteractionEvent entity, and the details of each contact are held in the Contact and Employee entities. Use the Contact ParticipatesIn InteractionEvent relationship to generate the list of interaction events associated with a particular contact.

The interaction events made during a particular time period

The date of each interaction event is held in the InteractionEvent entity. Use the date attribute to filter the list of interaction events to those made during a particular time period.

The information for all contacts available in a particular company

The details of each contact are held in the Contact and Employee entities, and the details of each company are held in the Company entity. Use the Employee WorksFor Company relationship to generate the information for all contacts available in a particular company.

The total number of phone calls made during a particular time period

The date and type of each interaction event are held in the InteractionEvent entity. Use the date and interactionEventType attributes to filter and then count the number of phone calls made during a particular time period.