2016

Fantastic Mobiles Database Model

Version 2.0

**Northeastern University | Team: Fantastic Mobiles**

**INFO 6210 DATA MANAGEMENT AND Database design**

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# **Revision History**

|  |  |  |  |
| --- | --- | --- | --- |
| **Date** | **Version** | **Description** | **Author** |
| 11/08/2016 | 1.0 | Initial draft | Shantam Gupta, Vaishali Lambe,  Yuxin Zhang,  Zhiyi Wang |
| 17/08/2016 | 2.0 | Added more specifications to the entities and attributes  Added high level design | Shantam Gupta, Vaishali Lambe,  Yuxin Zhang,  Zhiyi Wang |
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|  |  |  |  |

**Introduction**

The Database Model for Fantastic Mobile is a representation of a small scale Cellular Company database model. This model contains information about the services provided by the company with a special focus of the tracking mechanism to regulate the services

This model is used as a tool to understand the design and development of a database system created for a small scale Cellular Company. It also helps to understand the flow and storage of information within the database system.

This document covers the following:

* Assumptions used for creating this model
* Description of Entities and attributes
* The mapping of attributes and entities
* Primary, Unique and Foreign key constraints
* High Level Image of the model

The model has been created by Shantam Gupta, Vaishali Lambe, Yuxin Zhang, Zhiyi Wang for academic purposes under the guidance of Mr. Vincent Lattuada as part of his coursework for ***INFO6210 18748 Data Mgt and Database Design SEC 09 - Fall 2016*** at Northeastern University.

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# **Scope**

Scope describes the domain and the design boundaries of the associated database model including the rules and assumption used for designing the model.

This document contains information about the database design for a Cellular Company.

Database design includes, in scope and out of scope business requirements.

Also, it has entities like Customers, Location, Equipment, Service, Usage, Contract, Employee and Tower. This document elaborates and defines these entities and attributes associated with.

Though main focus of this Cellular Company database design is, phone usage and contracts/plans, it gives clear picture starting from customers purchasing a phone from a company to its usage, servicing the customers, maintain their records, and generate their bills, network connections too.

## **IN SCOPE:**

It includes all the details about the rules and assumptions made while designing this model that are present in the model. It helps to determine the inner domain of the model.

|  |  |
| --- | --- |
| **Sr. No.** | **Description** |
| **IS01** | **The Cellular Company sales Phone devices and SIM cards** |
| **IS02** | **The main focus of the Cellular Company is in providing data/text/voice services.** |
| **IS03** | **The Cellular Company tracks the customer service consumption** |
| **IS04** | **A Customer can have more than one phone number** |
| **IS05** | **A customer can send/receive text messages to more than one person at same instance** |
| **IS06** | **A customer can call more than one person at same instance** |
| **IS07** | **A customer can browse multiple WebPages at the same instant.** |
| **IS08** | **The customer has the flexibility to modify and change its contract.** |
| **IS09** | **Each Customer can have more than one phone device** |
| **IS10** | **Each Customer can have more than one contract** |
| **IS11** | **A Contract cannot exist without a customer.** |
| **IS12** | **Each type of contract can have many customers and SIM cards associated with it** |
| **IS13** | **Non sharing plans should be at phone level.** |
| **IS14** | **There exists a head customer for a family plan type of contract.** |
| **IS15** | **Metadata(duration and phone number of person associated with it) for voice service is being collected** |
| **IS16** | **Metadata(text length, text date and phone number of person associated with it) for text service is being collected** |
| **IS17** | **Metadata (data used, duration) for data service is being collected.** |
| **IS18** | **One SIM card can be switched from one equipment to another** |
| **IS19** | **Tracking of unique identification numbers like IMEI is required for each device.** |
| **IS20** | **A phone device can receive and transmit signals to/from more than one tower.** |
| **IS21** | **Each tower can receive and transmit multiple signals from more than one device within its specified range.** |
| **IS22** | **Employee can be a customer at the same time** |
| **IS23** | **Employee can serve one or more customers** |
| **IS24** | **Bill is generated based on consumption of services and contract** |
| **IS25** | **The head of the family plan customer pays the bill of the contract** |
| **IS26** | **Many Bills are generated for each contract for each customer** |

**OUT OF SCOPE:**

It provides details about the assumptions that have been used as a parameter for defining the design boundary for the development of the model. It includes those details which are not present in the model but are necessary to understand the functionality of the model.

Out-of-scope items contribute to simplify the content of this cellular model and embody the relationship between entities. Consequently, although these items are not included in the model, it is essential to understand them which helps to do a better design.

In this cellular model, out-of-scope items are as following.

|  |  |
| --- | --- |
| **Sr. No.** | **Description** |
| **OS01** | **More than one towers cannot send /receive the same signal at the same instance.** |
| **OS02** | **Customer feedback and other Quality features are beyond the scope of this model.** |
| **OS03** | **Collection of Marketing and Advertisement data is not in the scope of this model.** |
| **OS04** | **In house Manufacturing of products/services is beyond the scope of this model.** |
| **OS05** | **Provision of exceptional plans like international calling is beyond the scope of this model.** |
| **OS06** | **Tracking of malfunctioned equipment(s) is out of scope.** |
| **OS07** | **Postpaid Services are not incorporated in the design of the model.** |
| **OS08** | **The content of the data services consumed by a customer is not being collected.** |
| **OS09** | **There cannot be two or more heads in family plan like contract** |
| **OS10** | **The locking of customer accounts because of overshoot of stipulated contract limits is not captured by the model** |
| **OS11** | **Detail supplier info like supplier credibility is not captured in this model** |
| **OS12** | **Detail employee info for company insurance policy use is not required** |
| **OS13** | **Employee family phone/service discounts** |
| **OS14** | **Exchange of contracts is not permissible** |
| **OS15** | **Validation of customers’ identity is not done for purchase made by debit/credit card** |
| **OS16** | **Employee payroll system is not included the design** |
| **OS17** | **Sharing of unconsumed services is not permissible** |
| **OS18** | **Tracking of inventory of equipment is out of scope** |
| **OS19** | **Unconsumed services cannot be carry forwarded** |
| **OS20** | **There is no tracing of the end tower in a signal transmission** |

# **High Level Design:**

# 

# **Relations:**

It describes the connection between two entities, and also gives a representation of their association.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Name** | **Identifying** | **Parent Entity** | **Child Entity** | **Mandatory Child** | **Mandatory Parent** |
| Customer Phone | FALSE | Customer | Phone | FALSE | FALSE |
| ***Description:*** One customer can have more than one phone, phone can exist without customers | | | | | |
| Sim Cards installed in Phone | FALSE | Phone | SIM Card | FALSE | FALSE |
| Description: One phone can install more than one sim card, sim card can exist without a phone | | | | | |
| Customer Contract Purchased | TRUE | Customer | Contract | FALSE | TRUE |
| Description: contract cannot exist without customer, customer can have more than one contracts | | | | | |
| Text Usage under Contract | FALSE | Contract | Text | FALSE | TRUE |
| Description: text is part of contract | | | | | |
| Voice Usage under Contract | FALSE | Contract | Voice | FALSE | TRUE |
| Description: voice is part of contract | | | | | |
| Data Usage under Contract | FALSE | Contract | Data | FALSE | TRUE |
| Description: data is part of contract | | | | | |
| Contract is based on certain SIM Card | TRUE | SIM Card | Contract | FALSE | TRUE |
| Description: contract cannot exist without sim card | | | | | |
| Text Usage passing to Bill | FALSE | Bill | Text | FALSE | FALSE |
| Description: bill may or may not consider text usage | | | | | |
| Voice Usage passing to Bill | FALSE | Bill | Voice | FALSE | FALSE |
| Description: bill may or may not consider voice usage | | | | | |
| Data Usage passing to Bill | FALSE | Bill | Data | FALSE | FALSE |
| Description: bill may or may not consider data usage | | | | | |
| Customer using SIM Card | FALSE | Customer | SIM Card | FALSE | FALSE |
| Description: one customer can have 0 or more sim card, sim card can exist without customer | | | | | |
| Contract Phone | FALSE | Phone | Contract | FALSE | FALSE |
| Description: | | | | | |
| SIM Connectivity | TRUE | SIM Card | Signal | FALSE | TRUE |
| Description: signal cannot exist without sim card, signal record frequency | | | | | |
| Tower Communication | TRUE | Towers | Signal | FALSE | TRUE |
| Description: signal cannot exist without tower | | | | | |
| Location Flag | FALSE | Location | Towers | FALSE | TRUE |
| Description: | | | | | |
| SIM Service Type Flag | FALSE | Category | SIM Card | FALSE | FALSE |
| Description: sim card can exist without category | | | | | |
| Service Type Flag | FALSE | Category | Contract | FALSE | FALSE |
| Description: contract can exist without category | | | | | |
| Product Type Flag | FALSE | Category | Phone | FALSE | FALSE |
| Description: phone can exist without category | | | | | |
| Bill Generation required Contract Info | FALSE | Contract | Bill | TRUE | TRUE |
| Description: bill generated based on contract | | | | | |
| Employee work on Contract | FALSE | Employee | Contract | FALSE | FALSE |
| Description: employee can serve 0 or more contracts, contract can exist without employee | | | | | |
| Employee Address | TRUE | Address | Employee | TRUE | TRUE |
| Description: address cannot exist without employee | | | | | |
| Customer Address | FALSE | Address | Customer | TRUE | TRUE |
| Description: address cannot exist without customer | | | | | |

# **Entities & Attributes**

**Customer:** individuals who make a purchase in this cellphone company.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***Customer*** | | | | | |
| **Attribute Name:** | **Description:** | **Data Type(size)** | **Key:** | **Null or Not Null** | **Sample Data** |
| CustomerID | Customer ID,  the unique numbers and characters to represent each customer | Integer | Primary key | Not Null | 001234994,  021568833,  011245664,  035899903 |
| CustomerName | The names of customers | Varchar (20) |  | Not Null | JAMES GREEN,  TOM SMITH,  GABY SOLIS,  SUSAN MAYER |
| CustomerEmail | The Email address of customers | Varchar (30) |  | Not Null | [James00@gmail.com](mailto:James00@gmail.com)  [Smith21@gmail.com](mailto:Smith21@gmail.com)  [Gasol98@gmail.com](mailto:Gasol98@gmail.com)  [sumay33@gmail.com](mailto:sumay33@gmail.com) |
| Phone | The unique number which customer has for his phone | Varchar (11) |  | Not Null | 857-202-7856  857-201-6785  857-203-6688  857-205-5934 |

**Phone:**  the equipment that customers use.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***Phone*** | | | | | |
| **Attribute Name:** | **Description:** | **Data Type(size)** | **Key:** | **Null or Not Null** | **Sample Data** |
| IMEI | A unique 15 digit IMEI number which can be used to check the information of the device | BigInt | Primary key | Not Null | 159328532155345,  458376034895233,  593400857322953,  559321100577392 |
| Maker | The maker of the equipment | Varchar (20) |  | Not Null | Apple,  Samsung |
| Model | The exact model of the equipment | Varchar (20) |  | Not Null | iPhone 6s  Samsung note 7 |
| Year | When(the exact year) the equipment was made | Integer |  | Not Null | 2016,  2015,  2014 |
| Month | When(the exact month) the equipment was made | Integer |  | Not Null | 12,  11,  08 |
| CustomerID | Indicates which customer ID this IMEI related to | Integer | Foreign key |  | 001234994,  021568833,  011245664,  035899903 |
| CategoryID | The set of equipment having common features | Integer | Foreign  key |  | 1  2  3  4 |

**SIM Card:** A Subscriber Identity Module (SIM) card is a portable memory chip used mostly in cell phones that operate on the Global System for Mobile Communications network.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***Sim Card*** | | | | | |
| **Attribute Name:** | **Description:** | **Data Type(size)** | **Key:** | **Null or Not Null** | **Sample Data** |
| SimID | Sim ID,  the unique numbers to represent each sim card | Integer | Primary key | Not Null | 23495538210,  45989366694,  33593789632,  55938420552 |
| PhoneNumber | The phone number of each sim card | Varchar(11) |  | Not Null | 617-344-5633,  854-245-6644,  334-767-2278,  615-477-0943 |
| SimSizeType | The exact size of sim card | Char (5) |  | Not Null | Standard, Micro,  Nano |
| IMEI | Indicates which IMEI this simID related to | BigInt | Foreign key |  | 159328532155345,  458376034895233,  593400857322953,  559321100577392 |
| CustomerID | Indicates which customer ID this IMEI related to | Integer | Foreign key |  | 001234994,  021568833,  011245664,  035899903 |
| CategoryID | The set of equipment having common features | Integer | Foreign key |  | 1  2  3  4 |

**Contract:** A contract is a voluntary arrangement between two or more parties that is enforceable at law as a binding legal agreement. In this cellular model, customers sign contracts with cellphone company when they purchase plans. Contract includes the type of the contract, the concrete text, voice and data in the contract and the start time and end time of the contract.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***Contract*** | | | | | |
| **Attribute Name:** | **Description:** | **Data Type(size)** | **Key:** | **Null or Not Null** | **Sample Data** |
| ContractID | Contract ID, identifies each unique kind of the contract | Integer | Primary key | Not Null | 13112293,  13322989,  21322199,  21363278 |
| Type | The certain contract type that customers ordered | Varchar (20) |  | Not Null | Family Plan,  Personal Contract,  Pre-Paid |
| ContractText | Contract Text, the text allowed for the customer based on the certain contract | Integer |  | Not Null | 500,1000,900 |
| ContractVoice | Contract Voice, the voice of minutes allowed for the customer based on the certain contract | Time |  | Not Null | 100,300,500,  1000 |
| ContractData | Contract Data, the data plan in megabyte in the contract | Float |  | Not Null | 1000.23,500.001,  3000.002 |
| StartTime | Start Time, when the contract goes into effect | Time |  | Not Null | 01/13/2016  12/23/2015  03/18/2016 |
| EndTime | End Time, when the contract becomes invalid | Time |  | Not Null | 07/13/2016  06/23/2016  03/18/2017 |
| CustomerID | Indicates which customer this contract belongs to | Integer | Primary  Foreign  key | Not Null | 001234994,  021568833,  011245664,  035899903 |
| SimID | Indicates which SimID this contract related to | Integer | Primary  Foreign key | Not Null | 23495538210,  45989366694,  33593789632,  55938420552 |
| IMEI | Indicates which IMEI this contract related to | BigInt | Foreign key |  | 159328532155345,  458376034895233,  593400857322953,  559321100577392 |
| CategoryID | Indicates which category this contract belongs to | Integer | Foreign key |  | 1001  1002  1003 |
| EmployeeID | Indicated which employee is responsible for this contract | Integer | Foreign key |  | 122343776  547764388  975313609 |

**Text:** In this cellular model, text refers to the sending and receiving of text messages by mobile phone. Also, text includes the length of the text, when the text is sent or received and whether the text is sent or received. Each text has its unique textID and can be tracked in database.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***Text*** | | | | | |
| **Attribute Name:** | **Description:** | **Data Type(size)** | **Key:** | **Null or Not Null** | **Sample Data** |
| TextID | Text ID,  the unique numbers and characters to represent each text | Integer | Primary key | Not Null | 001228443,  349553422,  007438225,  448742201 |
| TextLength | The length of text content | Integer |  | Not Null | 100,200,  240 |
| TextDate | The exact date when the text was sent | Datetime |  | Not Null | 01/19/2016,  05/15/2016 |
| Beta\_PhoneNumber | The phone number which customer sending a text to or receiving a text from | Varchar(11) |  | Not Null | 857-201-7831  857-202-7892  857-203-4564  857-201-2256 |
| CustomerID | Indicates which customer this text belongs to | Integer | Foreign key | Not Null | 001234994,  021568833,  011245664,  035899903 |
| ContractID | Indicates which contract this text belongs to | Integer | Foreign key | Not Null | 13112293,  13322989,  21322199,  21363278 |
| BillID | Bill ID,  Indicated which bill this text related to | Integer | Foreign key |  | 001239292,  013322989,  021322199,  021363278 |
| SimID | Sim ID, indicates this text is sent from which Sim ID | Integer | Foreign key | Not Null | 23495538210,  45989366694,  33593789632,  55938420552 |

**Voice:** In this cellular model, voice refers to customers using their phones to give or receive a call. Also, voice includes the start date and end date of the voice and whether this voice is sent or received. Each voice is recorded and identified by a unique voice ID. Also, each voice can be track in this database.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***Voice*** | | | | | |
| **Attribute Name:** | **Description:** | **Data Type(size)** | **Key:** | **Null or Not Null** | **Sample Data** |
| VoiceID | Voice ID,  the unique numbers and characters to represent each voice | Integer | Primary key | Not Null | 335873324,  339855325,  998432001,  334500291 |
| VoiceDateStart | The start time of this voice | Datetime |  | Not Null | 02/04/2016 11:00,  02/03/2016  13:45 |
| VoiceDateEnd | The end time when this voice was over | Datetime |  | Not Null | 02/14/2016,  02/03/2016  03/10/2016 |
| Beta\_PhoneNumber | The phone number which customer calling to or receiving a call from | Varchar(11) |  | Not Null | 857-201-7834  857-202-7899  857-203-4563  857-201-2255 |
| CustomerID | Indicates which customer this voice belongs to | Integer | Foreign key | Not Null | 001234994,  021568833,  011245664,  035899903 |
| ContractID | Contract ID, indicates which contract this voice belongs to | Integer | Foreign key | Not Null | 13112293,  13322989,  21322199,  21363278 |
| BillID | Bill ID,  indicated which bill this voice related to | Integer | Foreign key |  | 001239292,  013322989,  021322199,  021363278 |
| SimID | Sim ID, indicates this voice is made from which Sim ID | Integer | Foreign key | Not Null | 23495538210,  45989366694,  33593789632,  55938420552 |

**Data:** In this cellular model, data include the total data in megabyte that customers used for connecting to the Internet and the date when the amount of data is used.Also, the usage of data can be tracked in this database.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***Data*** | | | | | |
| **Attribute Name:** | **Description:** | **Data Type(size)** | **Key:** | **Null or Not Null** | **Sample Data** |
| DataID | The unique numbers and characters to represent certain data | Integer | Primary key | Not Null | 440022345,  339857439,  349853203,  454893845 |
| DataUsed | Data in megabyte that customer used in one day | Float |  | Not Null | 2.0, 150,  400 |
| DataDate | The concrete date when data was used | Datetime |  | Not Null | 01/09/2015  02/15/2016  10/11/2016 |
| CustomerID | Indicates which customer this data belongs to | Integer | Foreign key | Not Null | 001234994,  021568833,  011245664,  035899903 |
| ContractID | Indicates which contract this dataused belongs to | Integer | Foreign key | Not Null | 13112293,  13322989,  21322199,  21363278 |
| BillID | Bill ID,  indicated which bill this data related to | Integer | Foreign key |  | 001239292,  013322989,  021322199,  021363278 |
| SimID | Sim ID, indicates the data is used by which Sim ID | Integer | Foreign key | Not Null | 23495538210,  45989366694,  33593789632,  55938420552 |

**Bill:** In this cellular model, bill includes the status of bill, tax, discount and the total money that the customers need to pay for the usage. Each bill is identified by a bill ID and can be track in this database.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***Bill*** | | | | | |
| **Attribute Name:** | **Description:** | **Data Type(size)** | **Key:** | **Null or Not Null** | **Sample Data** |
| BillID | Bill ID, identifies each unique bill | Integer | Primary key | Not Null | 001239292,  013322989,  021322199,  021363278 |
| Status | Status records whether bill has been paid or not | Varchar (10) |  | Not Null | Paid,  Unpaid |
| GrossBillTotal | The total bill before tax is included | Money |  | Not Null | $29.0, $36.1,  $40.5 |
| Discount | The discount of GrossBillTotal | Float |  | Not Null | 0  10%  20% |
| Tax | The total tax based on the GrossBillTotal and region | Money |  | Not Null | $5.25  $3.42  $4.65 |
| NetBillTotal | the amount bill of tax and GrossBillTotal after discount | Money |  | Not Null | $30.75  $25.68  $36.87 |
| CustomerID | Customer ID, indicates which customer this bill belongs to | Integer | Foreign key | Not Null | 001234994,  021568833,  011245664,  035899903 |
| ContractID | Contract ID, indicates which contract this bill belongs to | Integer | Foreign key | Not Null | 13112293,  13322989,  21322199,  21363278 |
| SimID | Sim ID, indicates which Sim ID this bill belongs to | Integer | Foreign key | Not Null | 23495538210,  45989366694,  33593789632,  55938420552 |

**Category:**The products/services type flag to identifies the product/service we sold, which the type could be either phone, SIM card, or contract

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***Category*** | | | | | |
| **Attribute Name:** | **Description:** | **Data Type (size)** | **Key:** | **Null or Not Null** | **Sample Data** |
| CategoryID | Category ID, identifies which SIM card is implementing this signal | Integer | Primary Key | Not Null | 131931233, 223292289, 221123199, 632212378 |
| CategoryType | Category Type, which indicates the type of products/services | Varchar (20) |  | Not Null | Phone, SIM Card, Contract |

**Employee:**The entity of record for our company employee’s information

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***Employee*** | | | | | |
| **Attribute Name:** | **Description:** | **Data Type (size)** | **Key:** | **Null or Not Null** | **Sample Data** |
| EmployeeID | Employee ID, the number identifies the unique employee in our company | Integer | Primary Key | Not Null | 631931233,  632212377,  632212376,  632212375 |
| EmployeeName | Employee Name, the attribute record of employee’s name | Varchar (20) |  | Not Null | Jake Wang,  Porter Robinson,  Donald Trump,  Jeff Sessions |
| HireDate | Hire Date, the record that when the certain employee started to be hired here | Datetime |  | Not Null | 3/2/16 12:00 AM,  5/2/16 12:00 AM,  5/2/16 12:00 AM,  11/12/16 12:00 AM |
| EmployeeEmail | Employee Email, the record of each employee email address for contact purpose | Varchar (40) |  | Not Null | [bigass@gmail.com](mailto:bigass@gmail.com),  [iLoveData@yahoo.com](mailto:iLoveData@yahoo.com),  [studymoreuntiltheworldend@qq.com](mailto:studymoreuntiltheworldend@qq.com), |
| Phone | Employee Phone, the record of employee phone number for contact purpose | Varchar (11) |  | Not Null | 7653920192,  8839291999,  3092019293,  +15762938891 |
| AddressID | Address ID, the foreign key which to indicates the employee address | Integer | Foreign Key | Not Null | 2938291,  2010293 |

**Address:**The entity of address record for persons involved with our business activities, which usually including customers and employees.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***Address*** | | | | | |
| **Attribute Name:** | **Description:** | **Data Type (size)** | **Key:** | **Null or Not Null** | **Sample Data** |
| AddressID | Address ID, identifies unique record of a certain address | Integer | Primary Key | Not Null | 2938291,  2010293 |
| StreetAddress | Street Address, record of the specific street address | Varchar (40) |  | Not Null | 107 Gordon St,  103 Boylston St #3,  270 S River Rd,  666 Great Dr |
| City | City, record of city name for the specific address | Varchar (20) |  | Not Null | Boston,  W Lafayette, Chicago |
| State | State, record of state name for the specific address | Varchar (20) |  | Not Null | MA, IN, IL, CA, NJ |
| Country | Country, record of country name for the specific address | Varchar (20) |  | Not Null | United States,  Canada, Mexico, China, Germany |
| Zipcode | Zip Code, record of zip code for the specific address | Integer |  | Not Null | 47906, 02134, 29392, 02135 |

**Location:** The traced place of a tower in the form of latitude and longitude

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***Bill*** | | | | | |
| **Attribute Name:** | **Description:** | **Data Type(size)** | **Key:** | **Null or Not Null** | **Sample Data** |
| Latitude | The angular distance of a tower north or south of the earth's equator for a tower | Float | Primary key | Not Null | 44.25  65.20  45.11  15.26 |
| Longitude | The angular distance of a tower east or west of the meridian | Float | Primary key | Not Null | 45.26  16.20  18.45  19.20 |

**Towers:** A cellular telephone site where antennae and electronic communications equipment are placed or other raised structure, to create a cell (or adjacent cells) in a cellular network.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***Bill*** | | | | | |
| **Attribute Name:** | **Description:** | **Data Type(size)** | **Key:** | **Null or Not Null** | **Sample Data** |
| TowerID | The unique number to identify a particular tower | Integer | Primary  key | Not Null | 1  2  3  4 |
| Latitude | The angular distance of a tower north or south of the earth's equator | Float | Foreign key | Not Null | 44.25  65.20  45.11  15.26 |
| Longitude | The angular distance of a tower east or west of the meridian | Float | Foreign key | Not Null | 45.26  16.20  18.45  19.20 |

**Signal:**The entity of signal connection between phone SIM card and signal tower, which indicates the record and connectivity of signal

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***Signal*** | | | | | |
| **Attribute Name:** | **Description:** | **Data Type (size)** | **Key:** | **Null or Not Null** | **Sample Data** |
| SimID | Sim Card ID, identifies which SIM card is implementing this signal | Integer | PFK | Not Null | 131122933, 133229289, 213221199, 213632278 |
| TowerID | Tower ID, identifies which tower is communicating with this signal | Integer | PFK | Not Null | 1929283, 1920229, 2020192, 2020192 |
| Frequency | The communicating frequency between tower and sim card, in unit of hertz(HZ) | Big Integer(BigInt) |  | Not Null | 800\*10^6,  1900\*10^6,  450\*10^6 |
| Time | The date and time this signal created | DateTime |  | Not Null | 11-17-2016 4:44p,  05-02-2014 2:30a |

**Glossary:**

|  |  |
| --- | --- |
| **Term** | **Description/Definition** |
| Primary Key | It is a special relational database table column (or combination of columns) designated to uniquely identify all table records |
| Foreign Key | It is a field (or collection of fields) in one table that uniquely identifies a row of another table |
| Primary Foreign Key | The foreign key is defined in a second table, but it refers to the primary key in the first table |
| Not Null | It is a constraint which enforces a table column to not accept NULL values |

**References:**

<http://databaseanswers.org/data_models/>

<http://stackoverflow.com/questions/9508564/dataset-or-entity-data-model>

<http://stackoverflow.com/questions/1196415/what-datatype-to-use-when-storing-latitude-and-longitude-data-in-sql-databases>

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