Golden Line

Telecom Company

Project Report

CS 6360

Section: 502

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1. Project Overview

a) Golden Lines is a telecom company that generally sells cell phones and SIM cards as its two chief merchandize.

b) Each SIM card can either be a prepaid or a postpaid device where as the cell phone if bought from the company must include its SIM card.

c) A service is provided cum assisted to the customer by the employee who could either be a sales representative or from a different department.

d) Employee's primary job is to describe various rate plans associated to the tariff, elaborate the voucher deals and most importantly to sell the merchandize to the customer.

e) Every SIM card must be availed with a particular tariff. Vouchers may or may not be required to be purchased.

f) A customer may or may not purchase the mobile device from the company since it is not requisite that a customer must purchase the device if he/she has to buy the SIM card.

EMPLOYEE

The employee is the sales representative who sells the merchandize to the customer. The role of employee is solely restricted to being sales representative or operator. Employee has its first name, last name, mobile number, employee id and a particular designation.

CUSTOMER

Customer is one of the primary entities of the system. He/she buys the device or the mobile number or both. He/she has an id, first name, last name, address, date of birth, email id. Email id is unique for the customer and hence also acts as a candidate key. Since the employee has to sell the merchandize to the customer he/she becomes an attribute of this customer relation.

Mobile Service, Transaction, Device and Device Detail

Mobile service is the chief entity that is bought by the customer. The primary attribute of the entity is the mobile number. Since a device has to be bought only if one wants to buy the mobile number, the relationship from device basically becomes a total participation. Device thus in this case obtains the mobile number as one of its attributes. Each device has a device name which brings out another entity by the device detail that holds the model type of the device, cost and the device name as its primary key.

Now the mobile service entity includes the tariff id, the status of the mobile service to ascertain if the mobile number is presently in the activated state or has been blocked or cancelled. Purchase date is the one that tells about the date when the mobile service was actually purchased. Activation ID talks about the date when the service was actually activated. Since it is the customer who actually buys the mobile service his/her id becomes one of the attributes of mobile service.

Transaction is associated to each mobile number. Hence mobile number comes as a foreign key in this relation. Transaction actually tells you about the total amount/balance to be paid for the mobile service. In general it gives a detail about the invoice generated for the mobile service for a particular month and when is the due date for the same. It also holds attributes like paid date, paid by, balance, amount paid, etc.

Tariff, Area, Rate

Tariff is the general plan that is required to be taken when the mobile service is actually bought. It basically gives you a particular plan that the mobile is going to use and can be changed whenever customer wanted to change it. Unless not asked to change, the tariff remains the same for a mobile service every month or perhaps even every year. Tariff comes out with a rate which comes as another entity. Rate talks about various rate plans that can come under the same tariff. Rate plans may have different cost expenditure for each of the call specifications like international or domestic or even different internet packages.

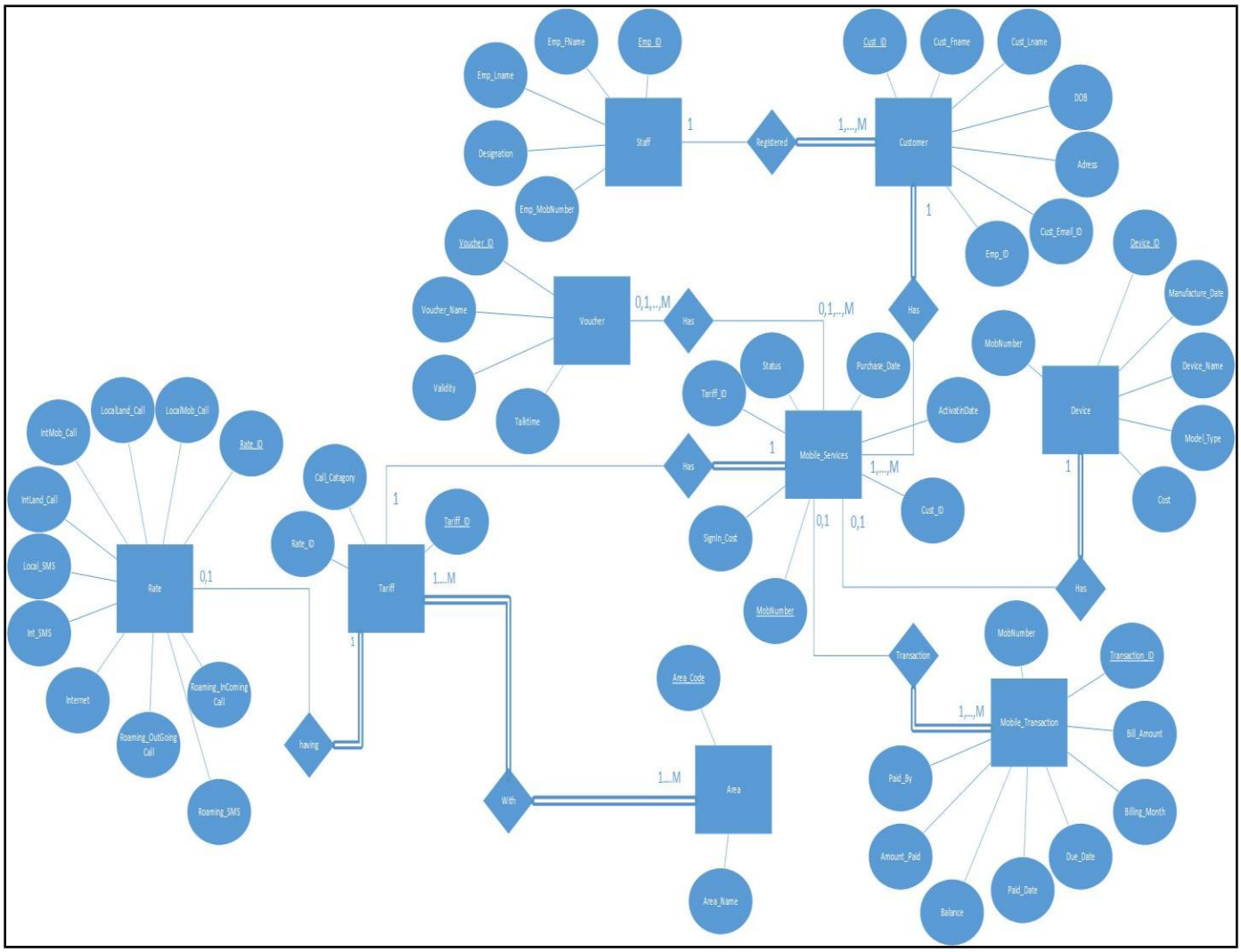
Each tariff is associated to a particular area and an area must have a tariff associated to it. Since same tariff is associated to multiple areas and each area can have multiple tariff plans, therefore there is a many to many relationship between these two entities. This relationship thus has a different entity.

Voucher

Voucher is an add-on that can be added to the current plan of the mobile number. It is like adding more money to get additional messaging service or reducing the call rate. Since a mobile number can use multiple vouchers at once and one voucher can be used by multiple mobile numbers therefore there is a many to many relationship between the two entities and hence a new entity comes into picture here.

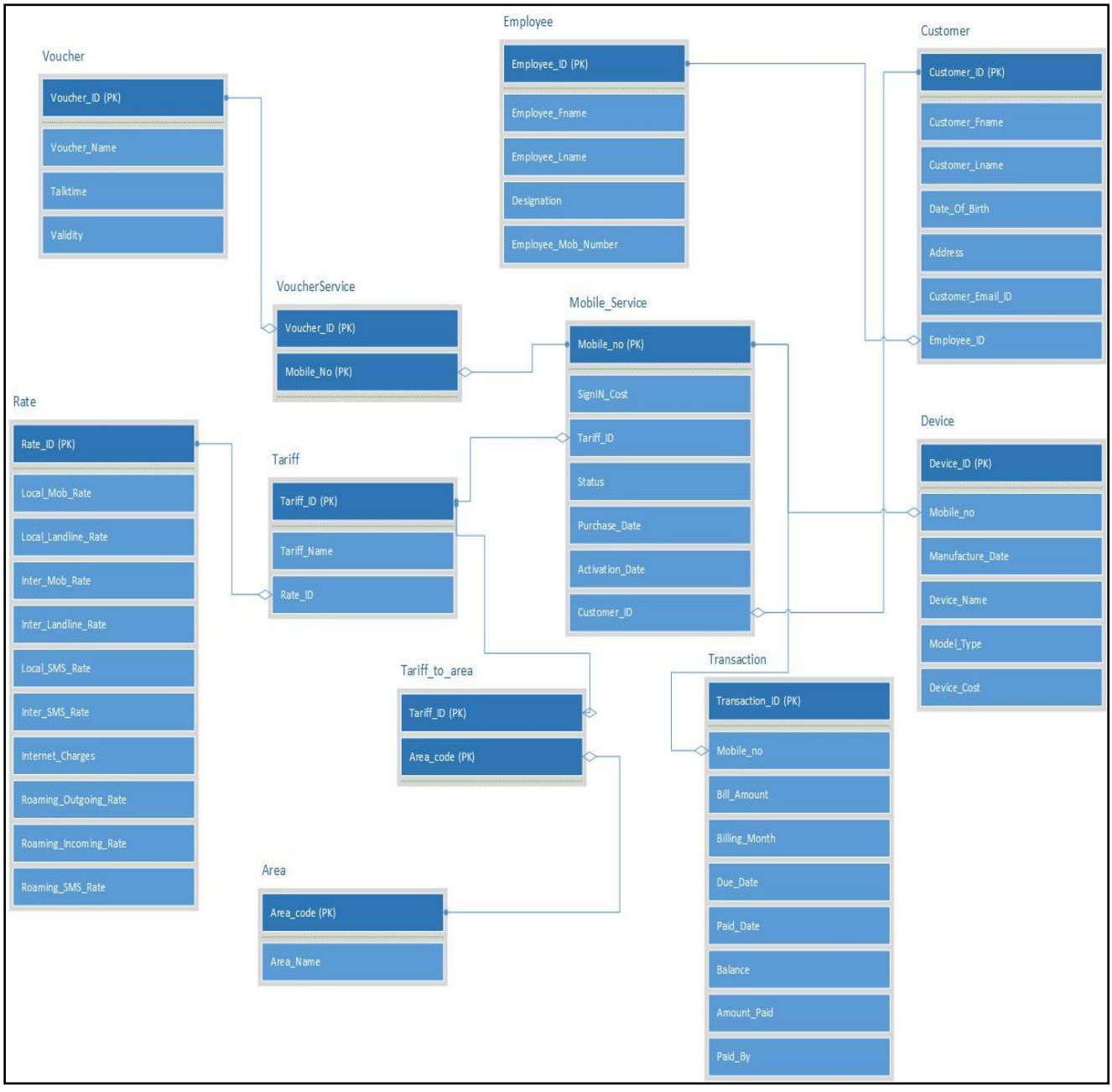
2. ER Diagram

ER_Diagram_GoldenLines.vsdx



3. Relational Schema

Relational_Schema_Step2.vsdx



4. Functional Dependency and Database Normalization

a) EMPLOYEE RELATION

The functional dependency of the relation is as under;
Employee_ID ⟶ {Employee_Fname, Employee_Lname, Designation, Employee_Mob_Number}

Employee_Mob_Number ⟶ {Employee_ID, Employee_Fname, Employee_Lname, Designation}

Employee ID is the primary key and thus a prime key attribute which directly determines the other fields of the relation.

Employee_Mob_Number is a candidate key and thus a prime key attribute which directly determines the other fields of the relation.

Since the fields are directly functional dependent on the prime attribute fields, therefore we can say the table is in 3NF form. The table is also in 1NF and 2NF forms. Hence the relation is represented as;

EMPLOYEE
EMPLOYEE_ID
EMPLOYEE_FNAME
EMPLOYEE_LNAME
DESIGNATION
EMPLOYEE_MOB_NUMBER

b) CUSTOMER RELATION

The functional dependency of the relation is as under;
Customer_ID ⟶ {Customer_Fname, Customer_Lname, Date_Of_Birth, Address, Customer_Email_ID, Employee_ID}

Customer_Email_ID ⟶ {Customer_ID, Customer_Fname, Customer_Lname, Date_Of_Birth, Address, Employee_ID}

Customer_ID is the primary key of the customer relation and hence becomes the prime attribute or key attribute. It directly determines all the fields of the relation.

Customer_Email_ID is the candidate key of the customer relation and is thus the prime or key attribute. It directly determines all the fields of the relation.

The relation is thus in the 3NF form since all the fields are functionally dependent on the key attributes. It is also in 2NF form.

Thus the relation in 3NF is as under;

CUSTOMER
CUSTOMER_ID
CUSTOMER_FNAME
CUSTOMER_LNAME
DATE_OF_BIRTH
ADDRESS
CUSTOMER_EMAIL_ID
EMPLOYEE_ID

c) MOBILE_SERVICE RELATION

The functional dependency is as under;
Mobile_No ⟶ {Signin_cost, Tariff_ID, Status, Purchase_Date, Activation_Date, Customer_ID}

Mobile_No is the primary key of the relation Mobile_Service and determines all the fields of the relation. Also there is no transitive dependency across the non-key attribute to non-key attribute coming from the key attribute.

The relation is in 3NF. Hence the relation in 3NF is represented as;

MOBILE_SERVICE
MOBILE_NO
SIGNIN_COST
TARIFF_ID
STATUS
PURCHASE_DATE
ACTIVATION_DATE
CUSTOMER_ID

d) TRANSACTION RELATION

The functional dependency is as under;
Transaction_ID ⟶ {Mobile_No, Bill_Amount, Billing_Month, Due_Date, Paid_Date, Balance, Amount_Paid, Paid_By}

Transaction_ID is the primary key and hence the key attribute. It directly determines the other fields of the relation and therefore no transitive dependency from non-key attribute to non-key attribute.

The relation is in 3NF. Hence the relation is represented as;

TRANSACTION
TRANSACTION_ID
MOBILE_NO
BILL_AMOUNT
BILLING_MONTH
DUE_DATE
PAID_DATE
BALANCE
AMOUNT_PAID
PAID_BY

e) VOUCHER RELATION

The functional dependency is as under;
Voucher_ID ⟶ {Voucher_Name, Talktime, Validity}

Voucher_ID is the primary key of the relation voucher. It is the sole key attribute and determines the non-key attributes without any transitive dependency in between.

The relation is in 3NF and it is represented as;

VOUCHER
VOUCHER_ID
VOUCHER_NAME
TALKTIME
VALIDITY

f) VOUCHER_SERVICE RELATION

The functional dependency is as under;
Voucher_ID ⟶ Mobile_No
Mobile_No ⟶ Voucher_ID
The primary keys are interdependent and hence the relation is in 3NF. There are no non-key attributes in the relation.

The relation is represented in 3NF as below;

VOUCHER_SERVICE
VOUCHER_ID
MOBILE_NO

g) RATE RELATION

The functional dependency is as under;
Rate_ID ⟶ {Local_Mob_Rate, Local_Landline_Rate, Inter_Mob_Rate, Inter_Landline_Rate, Local_SMS_Rate, Inter_SMS_Rate, Internet_Charges, Roaming_Outgoing_Rate, Roaming_Incoming_Rate, Roaming_SMS_Rate}

Rate_ID is the primary key and is also the sole key attribute. There is no transitive dependency and hence the relation also remains in 3NF.

The relation is represented in 3NF as below;

RATE
RATE_ID
LOCAL_MOB_RATE
LOCAL_LANDLINE_RATE
INTER_MOB_RATE
INTER_LANDLINE_RATE
LOCAL_SMS_RATE
INTER_SMS_RATE
INTERNET_CHARGES
ROAMING_OUTGOING_RATE
ROAMING_INCOMING_RATE
ROAMING_SMS_RATE

h) TARIFF RELATION

The functional dependency is as under;
Tariff_ID ⟶ {Tariff_Name, Rate_ID}
Tariff_ID is the primary key and this key attribute determines all the other fields directly.
There is no transitive dependency through any non-key attribute.
The relation is in 3NF and is represented as below.

TARIFF
TARIFF_ID
TARIFF_NAME
RATE_ID

i) TARIFF_TO_AREA RELATION

The functional dependency is as under;
Tariff_ID ⟶ Area_Code
Area_Code ⟶ Tariff_ID

Tariff_ID and Area_Code are the two primary key fields of the relation and are also interdependent on each other. Since there are no non-key attributes and no occurrence of transitive dependency either, this relation is in 3NF.

The relation in 3NF is represented as under;

TARIFF_TO_AREA
TARIFF_ID
AREA_CODE

j) AREA RELATION

The functional dependency is as under;
Area_Code ⟶ Area_Name
The only functional dependency is between Area_Code and Area_Name, where Area_Code is the primary key. Hence this relation is in 3NF.
The relation is represented as under;

AREA
AREA_CODE
AREA_NAME

k) DEVICE RELATION

The functional dependency is as under;
Device_ID⟶ {Mobile_No, Manufacture_Date, Device_Name, Model_Type, Device_Cost}
Mobile_No⟶ {Device_ID, Manufacture_Date, Device_Name, Model_Type, Device_Cost}
Device_Name⟶ {Model_Type, Device_Cost}

Device_ID is the primary key which directly determines the other fields.
Mobile_No is the candidate key and hence this key attribute determines the other key and non-key attributes.

Device_Name is a non-key attribute but determines Model_Type and Device_Cost.

In this relation we have the following transitive dependency;

Device_ID ⟶ Device_Name ⟶ {Model_Type, Device_Cost}

Also,
Mobile_No ⟶ Device_Name ⟶ {Model_Type, Device_Cost}

The current relation is not in 3NF.

In order to make the relation in 3NF, the current relation needs to be split up into two. The 3NF relations are thus as under;

DEVICE_DETAIL
DEVICE_NAME
MODEL_TYPE
DEVICE_COST

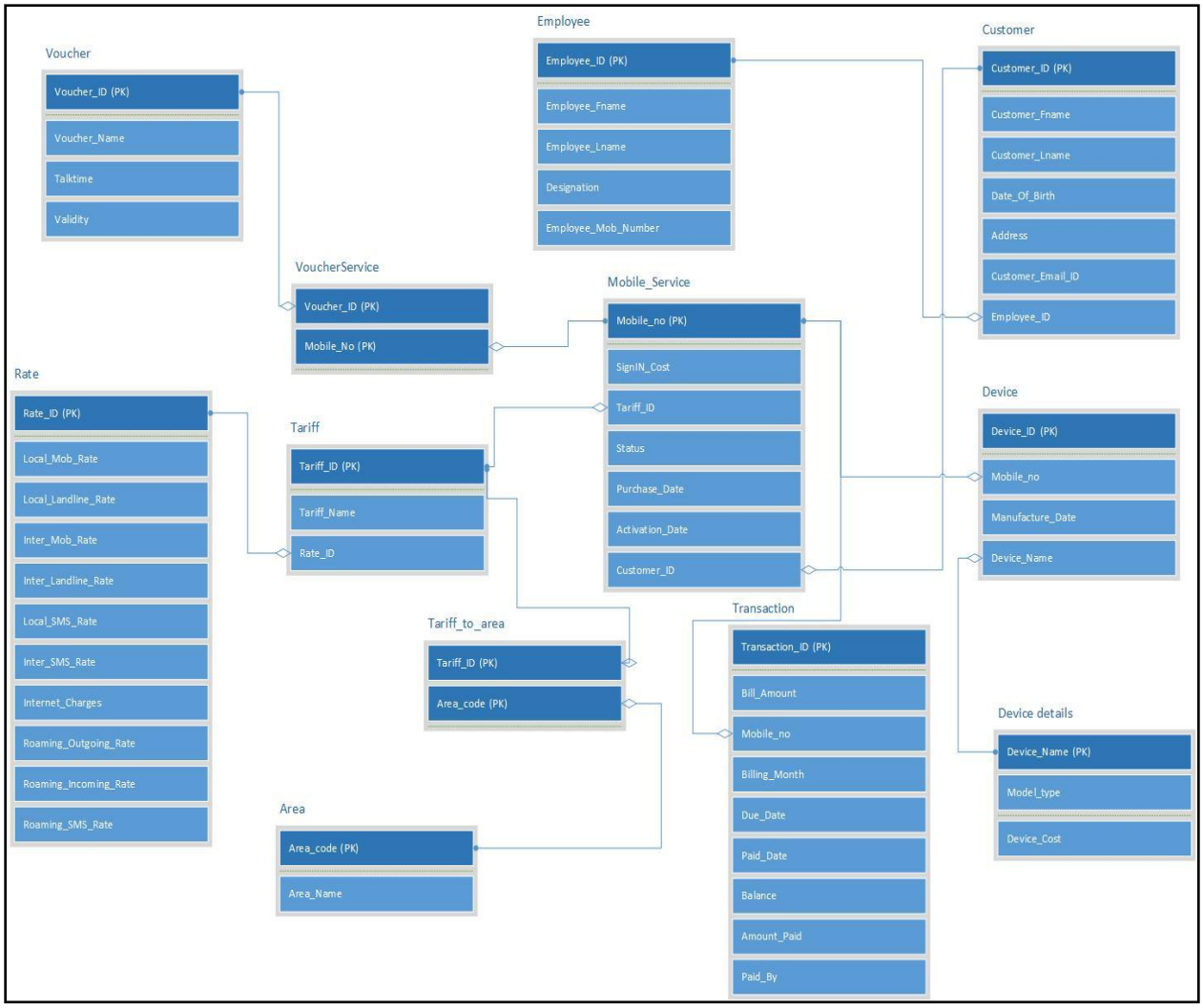
DEVICE
DEVICE_ID
MOBILE_NO
MANUFACTURE_DATE
DEVICE_NAME

The functional dependency of the new relations is as under;

Device_ID ⟶ {Mobile_No, Manufacture_Date, Device_Name}
Mobile_No ⟶ {Device_ID, Manufacture_Date, Device_Name}
Device_Name ⟶ {Model_Type, Device_Cost}

5. Final Relational Schema after Normalization

Relational_Schema_Step3.vsdx



6. SQL on Database with Result

a) CREATE SCHEMA goldenlines;

```
CREATE TABLE `goldenlines`.`employee` (
  `employee_id` INT NOT NULL,

`fname` VARCHAR(15) NULL,
 `lname` VARCHAR(15) NULL,

 `designation` VARCHAR(20) NULL,
 `employee_mobile_no` VARCHAR(10) NOT NULL,
 PRIMARY KEY (`employee_id`));

CREATE TABLE `goldenlines`.`customer` (
 `customer_id` INT NOT NULL,
 `cus_fname` VARCHAR(15) NOT NULL,
 `cus_lname` VARCHAR(15) NOT NULL,
 `date_of_birth` DATE NOT NULL,
 `address` VARCHAR(45) NULL,
 `cus_email_id` VARCHAR(45) NOT NULL,
 `employee_id` INT NULL,
 PRIMARY KEY (`customer_id`),
 UNIQUE INDEX `cus_email_id_UNIQUE` (`cus_email_id` ASC),
 INDEX `emp_employee_fk_idx` (`employee_id` ASC),
 CONSTRAINT `emp_employee_fk`
  FOREIGN KEY (`employee_id`)
  REFERENCES `goldenlines`.`employee` (`employee_id`)
  ON DELETE SET NULL
  ON UPDATE CASCADE);

CREATE TABLE `goldenlines`.`voucher` (
 `voucher_id` INT NOT NULL,
 `voucher_name` VARCHAR(20) NOT NULL,
 `talktime` VARCHAR(18) NOT NULL DEFAULT '100 minutes',
 `validity` VARCHAR(25) NULL,
 PRIMARY KEY (`voucher_id`));
```

```
CREATE TABLE `goldenlines`.`rate` (
  `rate_id` INT NOT NULL,
  `local_mob_rate` INT NULL,
  `local_landline_rate` INT NULL,
  `inter_mob_rate` INT NULL,
  `inter_landline_rate` INT NULL,
  `local_sms_rate` INT NULL,
  `inter_sms_rate` INT NULL,
  `internet_charges` VARCHAR(23) NULL,
  `roaming_outgoing_charge` VARCHAR(20) NULL,
  `roaming_incoming_charge` VARCHAR(20) NULL,
  `roaming_sms_rate` VARCHAR(20) NULL,
  PRIMARY KEY (`rate_id`));

CREATE TABLE `goldenlines`.`tariff` (
  `tariff_id` INT NOT NULL,
  `tariff_name` VARCHAR(20) NOT NULL,
  `rate_id` INT NOT NULL,
  PRIMARY KEY (`tariff_id`),
  INDEX `rate_rate_fk_idx` (`rate_id` ASC),
  CONSTRAINT `rate_rate_fk`
    FOREIGN KEY (`rate_id`)
    REFERENCES `goldenlines`.`rate` (`rate_id`)
    ON DELETE CASCADE
    ON UPDATE CASCADE);

CREATE TABLE `goldenlines`.`area` (
  `area_id` INT NOT NULL,
  `area_name` VARCHAR(40) NOT NULL,
  PRIMARY KEY (`area_id`));
```

```
CREATE TABLE `goldenlines`.`tariff_to_area` (
  `tariff_id` INT NOT NULL,
  `area_code` INT NOT NULL,
  PRIMARY KEY (`tariff_id`, `area_code`),
  INDEX `area_code_fk_idx` (`area_code` ASC),
  CONSTRAINT `tariff_tariff_fk`
    FOREIGN KEY (`tariff_id`)
    REFERENCES `goldenlines`.`tariff` (`tariff_id`)
    ON DELETE CASCADE
    ON UPDATE CASCADE,
  CONSTRAINT `area_code_fk`
    FOREIGN KEY (`area_code`)
    REFERENCES `goldenlines`.`area` (`area_id`)
    ON DELETE CASCADE
    ON UPDATE CASCADE);

CREATE TABLE `goldenlines`.`mobile_service` (
  `mobile_no` CHAR(10) NOT NULL,
  `signin_cost` VARCHAR(15) NOT NULL,
  `tariff_id` INT NULL DEFAULT 0,
  `status` VARCHAR(14) NULL,
  `purchase_date` DATE NULL,
  `activation_date` DATE NOT NULL,
  `customer_id` INT NOT NULL,
  PRIMARY KEY (`mobile_no`),
  INDEX `tar_tariff_fk_idx` (`tariff_id` ASC),
  INDEX `cus_customer_fk_idx` (`customer_id` ASC),
  CONSTRAINT `tar_tariff_fk`
    FOREIGN KEY (`tariff_id`)
    REFERENCES `goldenlines`.`tariff` (`tariff_id`)
    ON DELETE SET NULL
    ON UPDATE CASCADE,
  CONSTRAINT `cus_customer_fk`
    FOREIGN KEY (`customer_id`)
    REFERENCES `goldenlines`.`customer` (`customer_id`)
    ON DELETE CASCADE
    ON UPDATE CASCADE);
```

```
CREATE TABLE `goldenlines`.`voucher_service` (
  `voucher_id` INT NOT NULL,
  `mobile_no` CHAR(10) NOT NULL,
  PRIMARY KEY (`voucher_id`, `mobile_no`),
  INDEX `mob_mobile_fk_idx` (`mobile_no` ASC),
  CONSTRAINT `voucher_vouch_fk`
    FOREIGN KEY (`voucher_id`)
    REFERENCES `goldenlines`.`voucher` (`voucher_id`)
    ON DELETE CASCADE
    ON UPDATE CASCADE,
  CONSTRAINT `mob_mobile_fk`
    FOREIGN KEY (`mobile_no`)
    REFERENCES `goldenlines`.`mobile_service` (`mobile_no`)
    ON DELETE CASCADE
    ON UPDATE CASCADE);

CREATE TABLE `goldenlines`.`transaction` (
  `transaction_id` INT NOT NULL,
  `bill_amount` DECIMAL(20,5) NOT NULL,
  `mobile_no` CHAR(10) NOT NULL,
  `billing_month` VARCHAR(15) NOT NULL,
  `due_date` DATE NOT NULL,
  `paid_date` DATE NULL,
  `balance` DECIMAL(20,5) NULL,
  `amount_paid` DECIMAL(20,5) NULL,
  `paid_by` VARCHAR(15) NULL,
  PRIMARY KEY (`transaction_id`),
  INDEX `mob_mobil_fk_idx` (`mobile_no` ASC),
  CONSTRAINT `mob_mobil_fk`
    FOREIGN KEY (`mobile_no`)
    REFERENCES `goldenlines`.`mobile_service` (`mobile_no`)
    ON DELETE CASCADE
    ON UPDATE CASCADE);

CREATE TABLE `goldenlines`.`device_detail` (
  `device_name` VARCHAR(24) NOT NULL,
  `model_type` VARCHAR(15) NOT NULL,
  `device_cost` DECIMAL(10,2) NULL,
  PRIMARY KEY (`device_name`));
```

```
CREATE TABLE `goldenlines`.`device` (
  `device_id` INT NOT NULL,
  `mobile_no` CHAR(10) NOT NULL,
  `manufacture_date` DATE NOT NULL,
  `device_name` VARCHAR(24) NOT NULL,
  PRIMARY KEY (`device_id`),
  INDEX `mob_mob_fk_idx` (`mobile_no` ASC),
  INDEX `name_name_fk_idx` (`device_name` ASC),
  CONSTRAINT `mob_mob_fk`
    FOREIGN KEY (`mobile_no`)
    REFERENCES `goldenlines`.`mobile_service` (`mobile_no`)
    ON DELETE CASCADE
    ON UPDATE CASCADE,
  CONSTRAINT `name_name_fk`
    FOREIGN KEY (`device_name`)
    REFERENCES `goldenlines`.`device_detail` (`device_name`)
    ON DELETE CASCADE
    ON UPDATE CASCADE);
```

b)
```
INSERT INTO `goldenlines`.`employee` (`employee_id`, `fname`, `lname`, `designation`,
`employee_mobile_no`) VALUES ('100', 'Roger ', 'Waters', 'Sales Representator',
'9123456780');
INSERT INTO `goldenlines`.`employee` (`employee_id`, `fname`, `lname`, `designation`,
`employee_mobile_no`) VALUES ('101', 'Sky', 'Burns', 'Sales Representator',
'2145678902');
INSERT INTO `goldenlines`.`employee` (`employee_id`, `fname`, `lname`, `designation`,
`employee_mobile_no`) VALUES ('102', 'Ryan ', 'Kepps', 'Sales Representator',
'4698903124');
INSERT INTO `goldenlines`.`employee` (`employee_id`, `fname`, `lname`, `designation`,
`employee_mobile_no`) VALUES ('103', 'Brad', 'Williams', 'Sales Representator',
'4692134569');
INSERT INTO `goldenlines`.`employee` (`employee_id`, `fname`, `lname`, `designation`,
`employee_mobile_no`) VALUES ('104 ', 'Jerry', 'Tischer', 'Operator', '3893124567');

INSERT INTO `goldenlines`.`customer` (`customer_id`, `cus_fname`, `cus_lname`,
`date_of_birth`, `address`, `cus_email_id`, `employee_id`) VALUES ('200', 'John ', 'Smith',
'1978-11-09', '24-Brooklyn Apartments', 'john.smith@gmail.com', '100');
INSERT INTO `goldenlines`.`customer` (`customer_id`, `cus_fname`, `cus_lname`,
`date_of_birth`, `address`, `cus_email_id`, `employee_id`) VALUES ('201', 'Jason',
'Dorothy', '1996-10-04', '25-San Louis', 'jason_dorothy@yahoo.com', '100');
INSERT INTO `goldenlines`.`customer` (`customer_id`, `cus_fname`, `cus_lname`,
`date_of_birth`, `address`, `cus_email_id`, `employee_id`) VALUES ('202', 'Manoj',
'Rane', '1982-09-07', '22-Broadway Miles', 'manoj007@yahoo.com', '101');
```

```
INSERT INTO `goldenlines`.`customer` (`customer_id`, `cus_fname`, `cus_lname`,
`date_of_birth`, `address`, `cus_email_id`, `employee_id`) VALUES ('203', 'Boris',
'Wayne', '1980-09-11', '23-Irving Gardens', 'boris_wayne@gmail.com', '102');
INSERT INTO `goldenlines`.`customer` (`customer_id`, `cus_fname`, `cus_lname`,
`date_of_birth`, `address`, `cus_email_id`, `employee_id`) VALUES ('204', 'Curt', 'Mantis',
'1991-08-07', '33-St.James Park', 'curt_mantis@msn.com', '104');

INSERT INTO `goldenlines`.`voucher` (`voucher_id`, `voucher_name`, `talktime`,
`validity`) VALUES ('300', 'EasyMoney', '105 minutes', '15 days');
INSERT INTO `goldenlines`.`voucher` (`voucher_id`, `voucher_name`, `talktime`,
`validity`) VALUES ('301', 'ForInternational', '200 minutes', '30 days');
INSERT INTO `goldenlines`.`voucher` (`voucher_id`, `voucher_name`, `talktime`,
`validity`) VALUES ('302', 'ForDomestic', '180 minutes', '40 days');
INSERT INTO `goldenlines`.`voucher` (`voucher_id`, `voucher_name`, `talktime`,
`validity`) VALUES ('303', 'EasyMessaging', '68 minutes', '5 days');
INSERT INTO `goldenlines`.`voucher` (`voucher_id`, `voucher_name`, `talktime`,
`validity`) VALUES ('304', 'RoamLess', '120 minutes', '23 days');

INSERT INTO `goldenlines`.`rate` (`rate_id`, `local_mob_rate`, `local_landline_rate`,
`inter_mob_rate`, `inter_landline_rate`, `local_sms_rate`, `inter_sms_rate`,
`internet_charges`, `roaming_outgoing_charge`, `roaming_incoming_charge`,
`roaming_sms_rate`) VALUES ('400', '7', '6', '12', '11', '2', '4', '110$/month', '1$/min',
'0.8$/min', '1$/message');
INSERT INTO `goldenlines`.`rate` (`rate_id`, `local_mob_rate`, `local_landline_rate`,
`inter_mob_rate`, `inter_landline_rate`, `local_sms_rate`, `inter_sms_rate`,
`internet_charges`, `roaming_outgoing_charge`, `roaming_incoming_charge`,
`roaming_sms_rate`) VALUES ('401', '7', '8', '12', '12', '3', '5', '120$/month', '1$/min',
'0.9$/min', '1$/message');
INSERT INTO `goldenlines`.`rate` (`rate_id`, `local_mob_rate`, `local_landline_rate`,
`inter_mob_rate`, `inter_landline_rate`, `local_sms_rate`, `inter_sms_rate`,
`internet_charges`, `roaming_outgoing_charge`, `roaming_incoming_charge`,
`roaming_sms_rate`) VALUES ('402', '7', '6', '12', '11', '1', '3', '115$/month', '1$/min',
'0.7$/min', '1$/message');
INSERT INTO `goldenlines`.`rate` (`rate_id`, `local_mob_rate`, `local_landline_rate`,
`inter_mob_rate`, `inter_landline_rate`, `local_sms_rate`, `inter_sms_rate`,
`internet_charges`, `roaming_outgoing_charge`, `roaming_incoming_charge`,
`roaming_sms_rate`) VALUES ('403', '6', '5', '12', '11', '2', '5', '120$/month', '1$/min',
'1$/min', '2$/message');
INSERT INTO `goldenlines`.`rate` (`rate_id`, `local_mob_rate`, `local_landline_rate`,
`inter_mob_rate`, `inter_landline_rate`, `local_sms_rate`, `inter_sms_rate`,
`internet_charges`, `roaming_outgoing_charge`, `roaming_incoming_charge`,
`roaming_sms_rate`) VALUES ('404', '7', '9', '9', '8', '5', '6', '109$/month', '0.7$/min',
'0.5$/min', '1$/message');
```

```
INSERT INTO `goldenlines`.`tariff` (`tariff_id`, `tariff_name`, `rate_id`) VALUES ('500',
'HomeToHome', '400');
INSERT INTO `goldenlines`.`tariff` (`tariff_id`, `tariff_name`, `rate_id`) VALUES ('501',
'HomeZone', '400');
INSERT INTO `goldenlines`.`tariff` (`tariff_id`, `tariff_name`, `rate_id`) VALUES ('502',
'CorporateZone', '404');
INSERT INTO `goldenlines`.`tariff` (`tariff_id`, `tariff_name`, `rate_id`) VALUES ('503',
'FiberPlan', '402');
INSERT INTO `goldenlines`.`tariff` (`tariff_id`, `tariff_name`, `rate_id`) VALUES ('504',
'InternetBonanza', '403');


INSERT INTO `goldenlines`.`area` (`area_id`, `area_name`) VALUES ('600', 'Richardson');
INSERT INTO `goldenlines`.`area` (`area_id`, `area_name`) VALUES ('601', 'Plano');
INSERT INTO `goldenlines`.`area` (`area_id`, `area_name`) VALUES ('602 ',
'Bradfordshire');
INSERT INTO `goldenlines`.`area` (`area_id`, `area_name`) VALUES ('603', 'Westminster');
INSERT INTO `goldenlines`.`area` (`area_id`, `area_name`) VALUES ('604', 'Friscoe');

INSERT INTO `goldenlines`.`tariff_to_area` (`tariff_id`, `area_code`) VALUES ('500', '600');
INSERT INTO `goldenlines`.`tariff_to_area` (`tariff_id`, `area_code`) VALUES ('501', '600');
INSERT INTO `goldenlines`.`tariff_to_area` (`tariff_id`, `area_code`) VALUES ('500', '602');
INSERT INTO `goldenlines`.`tariff_to_area` (`tariff_id`, `area_code`) VALUES ('502', '600');
INSERT INTO `goldenlines`.`tariff_to_area` (`tariff_id`, `area_code`) VALUES ('503', '601');
INSERT INTO `goldenlines`.`tariff_to_area` (`tariff_id`, `area_code`) VALUES ('504', '604');
INSERT INTO `goldenlines`.`tariff_to_area` (`tariff_id`, `area_code`) VALUES ('504', '603');
INSERT INTO `goldenlines`.`tariff_to_area` (`tariff_id`, `area_code`) VALUES ('501', '604');
INSERT INTO `goldenlines`.`tariff_to_area` (`tariff_id`, `area_code`) VALUES ('503', '604');
INSERT INTO `goldenlines`.`tariff_to_area` (`tariff_id`, `area_code`) VALUES ('502', '601');

INSERT INTO `goldenlines`.`mobile_service` (`mobile_no`, `signin_cost`, `tariff_id`,
`status`, `purchase_date`, `activation_date`, `customer_id`) VALUES ('2147892134',
'50$', '500', 'Active', '2014-09-09', '2014-09-10', '200');
INSERT INTO `goldenlines`.`mobile_service` (`mobile_no`, `signin_cost`, `tariff_id`,
`status`, `purchase_date`, `activation_date`, `customer_id`) VALUES ('2052344657',
'60$', '500', 'Active', '2014-10-29', '2014-10-30', '200');
INSERT INTO `goldenlines`.`mobile_service` (`mobile_no`, `signin_cost`, `tariff_id`,
`status`, `purchase_date`, `activation_date`, `customer_id`) VALUES ('4697146789',
'23$', '502', 'Active', '2008-08-08', '2014-08-09', '201');
INSERT INTO `goldenlines`.`mobile_service` (`mobile_no`, `signin_cost`, `tariff_id`,
`status`, `purchase_date`, `activation_date`, `customer_id`) VALUES ('3458901344',
'40$', '501', 'Active', '2010-03-28', '2014-03-29', '201');
```

```
INSERT INTO `goldenlines`.`mobile_service` (`mobile_no`, `signin_cost`, `tariff_id`,
`status`, `purchase_date`, `activation_date`, `customer_id`) VALUES ('2142353412',
'35$', '502', 'Active', '2009-09-03', '2009-09-04', '202');
INSERT INTO `goldenlines`.`mobile_service` (`mobile_no`, `signin_cost`, `tariff_id`,
`status`, `purchase_date`, `activation_date`, `customer_id`) VALUES ('4562142344',
'38$', '501', 'Active', '2010-02-24', '2010-02-24', '202');
INSERT INTO `goldenlines`.`mobile_service` (`mobile_no`, `signin_cost`, `tariff_id`,
`status`, `purchase_date`, `activation_date`, `customer_id`) VALUES ('4123442345',
'56$', '503', 'Active', '2011-09-08', '2011-09-09', '203');
INSERT INTO `goldenlines`.`mobile_service` (`mobile_no`, `signin_cost`, `tariff_id`,
`status`, `purchase_date`, `activation_date`, `customer_id`) VALUES ('4224568978',
'50$', '503', 'Active', '2007-04-05', '2007-04-06', '203');
INSERT INTO `goldenlines`.`mobile_service` (`mobile_no`, `signin_cost`, `tariff_id`,
`status`, `purchase_date`, `activation_date`, `customer_id`) VALUES ('4127892133',
'12$', '500', 'Active', '2003-03-17', '2003-03-18', '204');
INSERT INTO `goldenlines`.`mobile_service` (`mobile_no`, `signin_cost`, `tariff_id`,
`status`, `purchase_date`, `activation_date`, `customer_id`) VALUES ('4238934569',
'13$', '500', 'Active', '2005-04-14', '2005-04-15', '204');

INSERT INTO `goldenlines`.`voucher_service` (`voucher_id`, `mobile_no`) VALUES ('300',
'2052344657');
INSERT INTO `goldenlines`.`voucher_service` (`voucher_id`, `mobile_no`) VALUES ('301',
'2142353412');
INSERT INTO `goldenlines`.`voucher_service` (`voucher_id`, `mobile_no`) VALUES ('302',
'2147892134');
INSERT INTO `goldenlines`.`voucher_service` (`voucher_id`, `mobile_no`) VALUES ('302',
'3458901344');
INSERT INTO `goldenlines`.`voucher_service` (`voucher_id`, `mobile_no`) VALUES ('302',
'4123442345');
INSERT INTO `goldenlines`.`voucher_service` (`voucher_id`, `mobile_no`) VALUES ('301',
'4127892133');
INSERT INTO `goldenlines`.`voucher_service` (`voucher_id`, `mobile_no`) VALUES ('304',
'4224568978');
INSERT INTO `goldenlines`.`voucher_service` (`voucher_id`, `mobile_no`) VALUES ('303',
'2052344657');

INSERT INTO `goldenlines`.`transaction` (`transaction_id`, `bill_amount`, `billing_month`,
`due_date`, `balance`, `amount_paid`, `mobile_no`) VALUES ('700', '70.09', 'December ',
'2014-12-24', '70.09', '0.00', '2052344657');
INSERT INTO `goldenlines`.`transaction` (`transaction_id`, `bill_amount`, `billing_month`,
`due_date`, `paid_date`, `balance`, `amount_paid`, `paid_by`, `mobile_no`) VALUES
('701', '47.90', 'October', '2012-03-15', '2012-03-19', '0.00', '49.90', 'Myself',
'2142353412');
```

```
INSERT INTO `goldenlines`.`transaction` (`transaction_id`, `bill_amount`, `billing_month`,
`due_date`, `paid_date`, `balance`, `amount_paid`, `paid_by`, `mobile_no`) VALUES
('702', '35.908', 'March', '2013-08-12', '2013-08-12', '0.00000', '35.908', 'Brother',
'2147892134');
INSERT INTO `goldenlines`.`transaction` (`transaction_id`, `bill_amount`, `billing_month`,
`due_date`, `paid_date`, `balance`, `amount_paid`, `paid_by`, `mobile_no`) VALUES
('703', '36.704', 'April', '2012-09-11', '2012-09-10', '1.00000', '35.704', 'Myself',
'3458901344');
INSERT INTO `goldenlines`.`transaction` (`transaction_id`, `bill_amount`, `billing_month`,
`due_date`, `paid_date`, `balance`, `amount_paid`, `paid_by`, `mobile_no`) VALUES
('704', '56.0004', 'June', '2013-08-12', '2013-08-12', '3.00000', '52.0004', 'Myself',
'4123442345');
INSERT INTO `goldenlines`.`transaction` (`transaction_id`, `bill_amount`, `billing_month`,
`due_date`, `paid_date`, `balance`, `amount_paid`, `paid_by`, `mobile_no`) VALUES
('705', '52.0005', 'July', '2014-09-14', '2014-09-20', '5.00000', '54.00008', 'Myself',
'4127892133');
INSERT INTO `goldenlines`.`transaction` (`transaction_id`, `bill_amount`, `billing_month`,
`due_date`, `paid_date`, `balance`, `amount_paid`, `paid_by`, `mobile_no`) VALUES
('706', '41.00034', 'September', '2013-08-01', '2013-08-02', '3.90800', '40.00023',
'Myself', '4224568978');
INSERT INTO `goldenlines`.`transaction` (`transaction_id`, `bill_amount`, `billing_month`,
`due_date`, `paid_date`, `balance`, `amount_paid`, `paid_by`, `mobile_no`) VALUES
('707', '67.00023', 'August', '2012-09-12', '2012-09-12', '2.00023', '65.00000', 'Wife',
'4238934569');
INSERT INTO `goldenlines`.`transaction` (`transaction_id`, `bill_amount`, `billing_month`,
`due_date`, `paid_date`, `balance`, `amount_paid`, `paid_by`, `mobile_no`) VALUES
('708', '51.00029', 'March', '2014-09-11', '2014-09-11', '0.00000', '51.00029', 'Myself',
'4562142344');
INSERT INTO `goldenlines`.`transaction` (`transaction_id`, `bill_amount`, `billing_month`,
`due_date`, `paid_date`, `balance`, `amount_paid`, `paid_by`, `mobile_no`) VALUES
('709', '53.12000', 'May', '2014-10-12', '2014-10-24', '12.12000', '57.00000', 'Myself',
'4697146789');

INSERT INTO `goldenlines`.`device_detail` (`device_name`, `model_type`, `device_cost`)
VALUES ('iPhone 4S', '4S', '400$');
INSERT INTO `goldenlines`.`device_detail` (`device_name`, `model_type`, `device_cost`)
VALUES ('Samsung Galaxy', 'Tab', '450$');
INSERT INTO `goldenlines`.`device_detail` (`device_name`, `model_type`, `device_cost`)
VALUES ('iPhone 5S', '5S', '478$');
INSERT INTO `goldenlines`.`device_detail` (`device_name`, `model_type`, `device_cost`)
VALUES ('Nokia X-Series', 'X-124', '289$');
INSERT INTO `goldenlines`.`device_detail` (`device_name`, `model_type`, `device_cost`)
VALUES ('Motorola G', 'GZ890', '500$');
```

```
INSERT INTO `goldenlines`.`device` (`device_id`, `manufacture_date`, `device_name`,
`mobile_no`) VALUES ('800', '2014-09-09', 'iPhone 4S', '3458901344');
INSERT INTO `goldenlines`.`device` (`device_id`, `manufacture_date`, `device_name`,
`mobile_no`) VALUES ('801', '2014-10-11', 'iPhone 5S', '4127892133');
INSERT INTO `goldenlines`.`device` (`device_id`, `manufacture_date`, `device_name`,
`mobile_no`) VALUES ('802', '2012-08-09', 'Motorola G', '4224568978');
INSERT INTO `goldenlines`.`device` (`device_id`, `manufacture_date`, `device_name`,
`mobile_no`) VALUES ('803', '2013-07-14', 'Samsung Galaxy', '4697146789');
INSERT INTO `goldenlines`.`device` (`device_id`, `manufacture_date`, `device_name`,
`mobile_no`) VALUES ('804', '2012-09-12', 'Samsung Galaxy', '4562142344');
INSERT INTO `goldenlines`.`device` (`device_id`, `manufacture_date`, `device_name`,
`mobile_no`) VALUES ('805', '2013-08-08', 'Nokia X-Series', '2052344657');
```

c) SELECT cus_fname, cus_lname, fname, lname FROM goldenlines.customer AS C, goldenlines.employee AS E where c.employee_id = e.employee_id AND c.employee_id = 100;

Result Grid | Filter Rows:

cus_fname	cus_lname	fname	lname
John	Smith	Roger	Waters
Jason	Dorothy	Roger	Waters

d) SELECT t.rate_id, COUNT(*), internet_charges FROM goldenlines.tariff AS t, goldenlines.rate AS r WHERE t.rate_id = r.rate_id GROUP BY t.rate_id;

rate_id	COUNT(*)	internet_charges
400	2	110$/month
402	1	115$/month
403	1	120$/month
404	1	109$/month

e) SELECT t.mobile_no, t.device_name, r.customer_id FROM goldenlines.mobile_service AS r JOIN goldenlines.device AS t ON t.mobile_no = r.mobile_no;

mobile_no	device_name	customer_id
3458901344	iPhone 4S	201
4127892133	iPhone 5S	204
4224568978	Motorola G	203
4697146789	Samsung Galaxy	201
4562142344	Samsung Galaxy	202
2052344657	Nokia X-Series	200

f) DELETE CASCADE

a) *Before Delete Operation on MOBILE_SERVICE*

MOBILE_SERVICE

mobile_no	signin_cost	tariff_id	status	purchase_date	activation_date	customer_id
2052344657	60$	500	Active	2014-10-29	2014-10-30	200
2142353412	35$	502	Active	2009-09-03	2009-09-04	202
2147892134	50$	500	Active	2014-09-09	2014-09-10	200
3458901344	40$	501	Active	2010-03-28	2014-03-29	201
4123442345	56$	503	Active	2011-09-08	2011-09-09	203
4127892133	12$	500	Active	2003-03-17	2003-03-18	204
4224568978	50$	503	Active	2007-04-05	2007-04-06	203

DEVICE

800	2014-09-09	iPhone 4S	3458901344
801	2014-10-11	iPhone 5S	4127892133
802	2012-08-09	Motorola G	4224568978
803	2013-07-14	Samsung Galaxy	4697146789
804	2012-09-12	Samsung Galaxy	4562142344
805	2013-08-08	Nokia X-Series	2052344657

TRANSACTION

transaction_id	bill_amount	billing_month	due_date	paid_date	balance	amount_paid	paid_by	mobile_no
701	47.90000	October	2012-03-15	2012-03-19	0.00000	49.90000	Myself	2142353412
702	35.90800	March	2013-08-12	2013-08-12	0.00000	35.90800	Brother	2147892134
703	36.70400	April	2012-09-11	2012-09-10	1.00000	35.70400	Myself	3458901344
704	56.00040	June	2013-08-12	2013-08-12	3.00000	52.00040	Myself	4123442345
705	52.00050	July	2014-09-14	2014-09-20	5.00000	54.00008	Myself	4127892133
706	41.00034	September	2013-08-01	2013-08-02	3.90800	40.00023	Myself	4224568978
707	67.00023	August	2012-09-12	2012-09-12	2.00023	65.00000	Wife	4238934569
708	51.00029	March	2014-09-11	2014-09-11	0.00000	51.00029	Myself	4562142344
709	53.12000	May	2014-10-12	2014-10-24	12.12000	57.00000	Myself	4697146789

VOUCHER_SERVICE

voucher_id	mobile_no
300	2052344657
303	2052344657
301	2142353412
302	2147892134
302	3458901344
302	4123442345
301	4127892133
304	4224568978

b) *After Deletion operation is performed on MOBILE_SERVICE where MOBILE_NO = '3458901344'*

DELETE FROM goldenlines.mobile_service WHERE mobile_no = '3458901344';

MOBILE_SERVICE

mobile_no	signin_cost	tariff_id	status	purchase_date	activation_date	customer_id
2052344657	60$	500	Active	2014-10-29	2014-10-30	200
2142353412	35$	502	Active	2009-09-03	2009-09-04	202
2147892134	50$	500	Active	2014-09-09	2014-09-10	200
4123442345	56$	503	Active	2011-09-08	2011-09-09	203
4127892133	12$	500	Active	2003-03-17	2003-03-18	204
4224568978	50$	503	Active	2007-04-05	2007-04-06	203
4238934569	13$	500	Active	2005-04-14	2005-04-15	204
4562142344	38$	501	Active	2010-02-24	2010-02-24	202
4697146789	23$	502	Active	2008-08-08	2014-08-09	201

DEVICE

device_id	manufacture_date	device_name	mobile_no
801	2014-10-11	iPhone 5S	4127892133
802	2012-08-09	Motorola G	4224568978
803	2013-07-14	Samsung Galaxy	4697146789
804	2012-09-12	Samsung Galaxy	4562142344
805	2013-08-08	Nokia X-Series	2052344657

TRANSACTION

transaction_id	bill_amount	billing_month	due_date	paid_date	balance	amount_paid	paid_by	mobile_no
701	47.90000	October	2012-03-15	2012-03-19	0.00000	49.90000	Myself	2142353412
702	35.90800	March	2013-08-12	2013-08-12	0.00000	35.90800	Brother	2147892134
704	56.00040	June	2013-08-12	2013-08-12	3.00000	52.00040	Myself	4123442345
705	52.00050	July	2014-09-14	2014-09-20	5.00000	54.00008	Myself	4127892133
706	41.00034	September	2013-08-01	2013-08-02	3.90800	40.00023	Myself	4224568978
707	67.00023	August	2012-09-12	2012-09-12	2.00023	65.00000	Wife	4238934569
708	51.00029	March	2014-09-11	2014-09-11	0.00000	51.00029	Myself	4562142344
709	53.12000	May	2014-10-12	2014-10-24	12.12000	57.00000	Myself	4697146789

VOUCHER_SERVICE

voucher_id	mobile_no
300	2052344657
303	2052344657
301	2142353412
302	2147892134
302	4123442345
301	4127892133
304	4224568978

Delete cascade constraint is applied over all the relations that refer MOBILE_NO as the foreign key which is the primary key of the relation MOBILE_SERVICE. So in case if the mobile number is removed from MOBILE_SERVICE the related relations shall be affected. Since relations like transaction, device and voucher_service have mobile_no is an important field and must be present in each of these relations (It means mobile_no cannot be NULL in these relations) the delete cascade operation is thus used.

g)
```
ALTER TABLE `goldenlines`.`voucher_service`
ADD COLUMN `employee_id` INT NULL AFTER `mobile_no`,
ADD INDEX `emp_empl_fk_idx` (`employee_id` ASC);
ALTER TABLE `goldenlines`.`voucher_service`
ADD CONSTRAINT `emp_empl_fk`
  FOREIGN KEY (`employee_id`)
  REFERENCES `goldenlines`.`employee` (`employee_id`)
  ON DELETE SET NULL
  ON UPDATE CASCADE;
```

h)
```
ALTER TABLE `goldenlines`.`voucher_service`
DROP FOREIGN KEY `emp_empl_fk`;

ALTER TABLE `goldenlines`.`voucher_service`
DROP COLUMN `employee_id`,
DROP INDEX `emp_empl_fk_idx` ;
```

i) SELECT a.transaction_id, a.bill_amount, a.billing_month, a.due_date FROM customer c, transaction a, employee e, mobile_service m where c.employee_id = e.employee_id AND c.customer_id = m.customer_id AND a.mobile_no = m.mobile_no AND e.employee_id = 100 UNION
SELECT a.transaction_id, a.bill_amount, a.billing_month, a.due_date FROM customer c, transaction a, employee e, mobile_service m where c.employee_id = e.employee_id AND c.customer_id = m.customer_id AND a.mobile_no = m.mobile_no AND e.employee_id = 101;

transaction_id	bill_amount	billing_month	due_date
700	70.09000	December	2014-12-24
702	35.90800	March	2013-08-12
709	53.12000	May	2014-10-12
701	47.90000	October	2012-03-15
708	51.00029	March	2014-09-11

j) DELETE FROM goldenlines.transaction;
DROP table goldenlines.transaction;