SOFTWARE DESIGN DOCUMENT

FOR

TRACEBILL SYSTEM

Prepared By TraceBill team

VERSION 1.0

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REVISION HISTORY

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1. Introduction

The Software Design Document is a document to provide documentation which will be used to aid in the development of the TraceBill System by providing the details for how the software should be built. Within the Software Design Document are narrative and graphical documentation of the software design for the project including use case models, sequence diagrams, collaboration models, object behavior models, and other supporting requirement information.

3.1 Purpose

This software design document describes how the Tracebill system is designed. It also explains the architecture of the software, shows the models and explains the way the software works. The intended audiences of this document are the Tracebill system users, software developers and system design analyst.

3.2 Scope

The Software Design Document covers the design of the TraceBill system from new customer connection application, installation of the customer meter to reading of the customer's meter to billing of the customer (this includes all necessary adjustments), generating and delivering bills, capturing bill payments and producing of reports as per the request or requirements of a given user of the system.

3.3 Overview

Section 1 and **Section 2** provide a general overview of the document and prepare the reader so that he/she understands the sections that follow. **Section 6** provides information about the application to the end user. The rest of the document is meant for the system developers of the Tracebill system. The sections are broken down as follows.

Section 3 describes the architecture of the system which is a conceptual representation of components and subcomponents that reflect the behavior of a system.

Section 4 describes the data elements to be used in the Tracebill and how they interact with each other to satisfy various states of the system

Section 5 outlines the components of the system and describes what each component does in a more systematic way.

Section 6 describes what the system is intended to look like when it is finished/implemented.

3.4 Reference Material

Tracebill Team, "Software Requirements Specification,", [2nd, June, 2020] TraceCorp Solutions

3.5 Acronyms, Definitions and Abbreviations

Here are definitions for the acronyms that will be used throughout the document;

API -Applications Programming Interface

2. System Design and Architecture

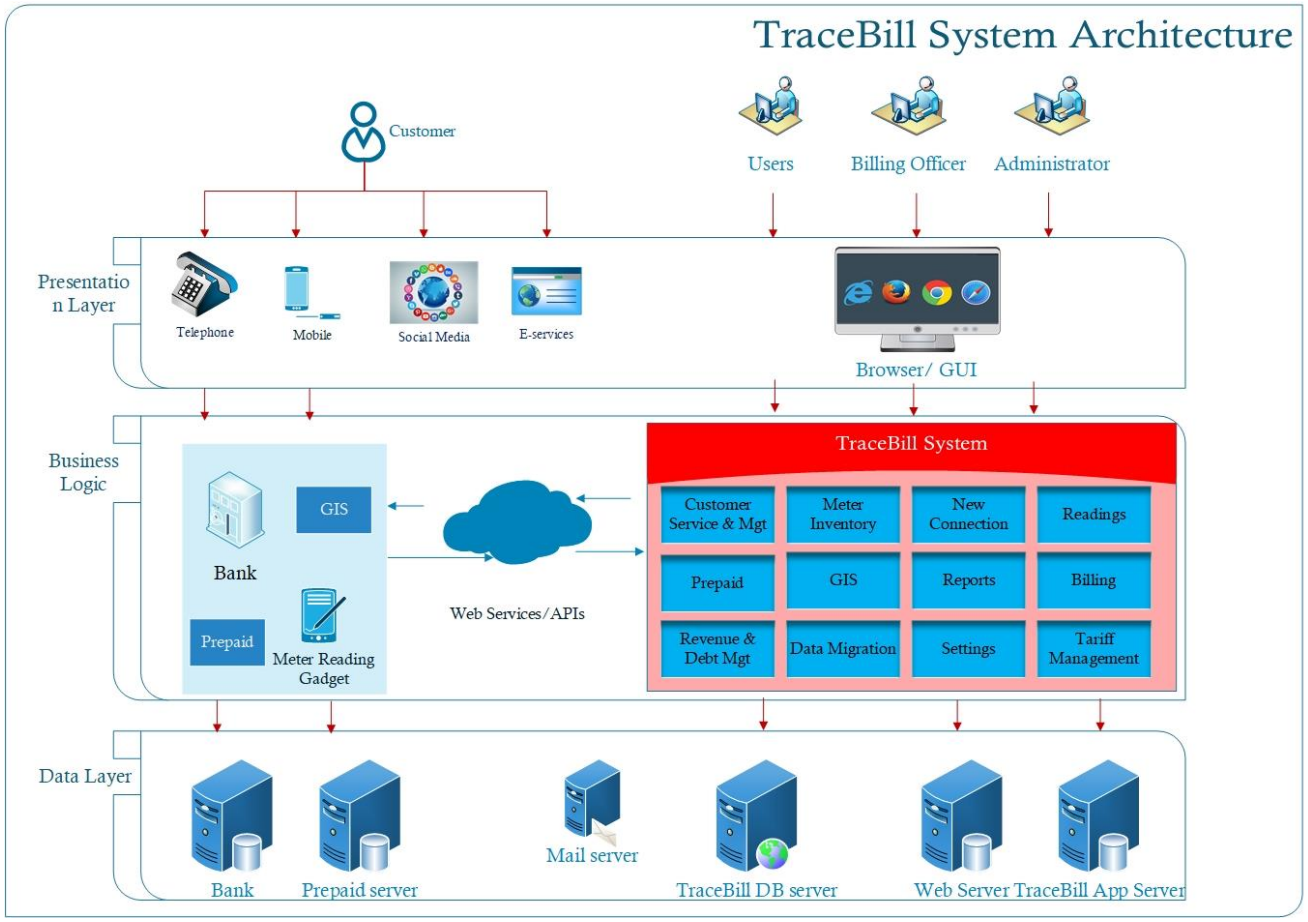

Figure 1 Overall System Architecture

The proposed TraceBill system architecture demonstrates the different components involved in the system according to the specified requirements and how all these components interact with each other. As such, the process starts at the Presentation layer where end user or system user accesses the system through a browser using a Graphical User interface and the customers interact with it through placing direct calls, the company's website (E-services) as well as social media interfaces. The requests from customers, meter reading gadgets as well as external systems will be managed through webservices or Application Programming Interfaces (APIs) at the business logic layer and in turn relayed to the Database which handles storage and manipulation of data which is the data layer. There will be email

notifications to specified users in the system hence interaction with the utility company's mail server. The system will also be integrated with the Prepaid Billing and GIS systems according to the client's request.

All system users will be required to log in and be authenticated by the servers before they can access the system.

3. Logical architecture

3.1 Use case diagram

The use case diagram below: Figure 2, illustrates the proposed functionality of the TraceBill system. The subsequent tables outline the actors, preconditions, and main flow of events of each use case.

3.1.1 New connections module use case diagram

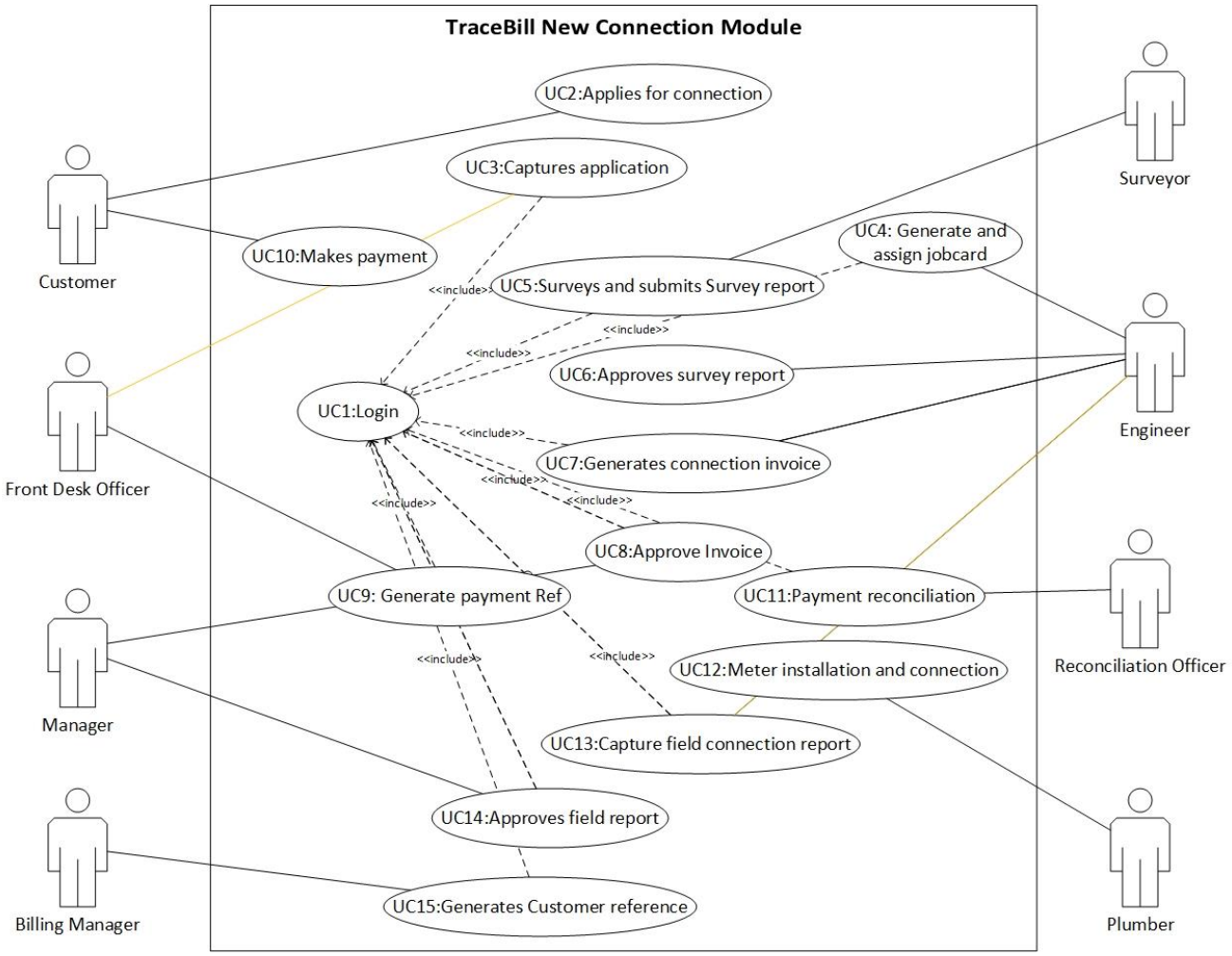

Figure 2 Use Case Diagram for TraceBill New Connection module

Use case specifications

Use Case: Login
ID: UC1
Brief Description: Sign in so as to access and use the system
Actors: Front Desk Officer, Manager, Billing Manager, Surveyor, Engineer, Billing Officer, Customer
Preconditions: 1. The user has accessed the application using a browser 2. The user needs a username and password the system
Main flow: 1. The user enters his/her user name 2. The user enters his/her password 3. If the login details are correct 3.1. The user is allowed to access the system 4. Else 4.1. The user is denied access to the system
Post conditions: 1. Access has been granted to the user.

Use Case: Apply for a connection
ID: UC2
Brief Description: Capture application details and save the application.
Actors: Customer, Commercial Officer
Preconditions: 1. The user must be logged in. 2. There should be already defined ID types, proposed class and connection size in a dropdown list
Main flow: 1. Include (Login) 2. The user inputs the name, contact, email address, ID and location details 3. The user attaches the copies of files like ID copy, proof of

ownership and passport size photos among others 4. The user saves the application
Post conditions: 1. The application is assigned a unique application ID and committed to the database 2. The customer must be given a unique payment reference number 3. The status of the customer application is changed and logged

Use Case: Capture Application
ID: UC3
Brief Description: Capture and save the details of the customer details
Actors: Commercial Officer
Preconditions: 1. The user must be logged in
Main flow: 1. Include (Login) 2. The user captures the customer biodata details 3. The user scans and uploads the customer's copies of the mandatory requirements like passport size photo, proof of ownership, ID copy among others
Post conditions: 1. The application is assigned a unique application ID and committed to the database 2. The customer must be given a unique reference number 3. The status of the customer application is changed and logged
Use Case: Generate and assign job card
ID: UC4
Brief Description: A job card that entails survey questions is generated, assigned to the respective surveyor
Actors: Engineer
Preconditions: 1. The user must be logged in as an Engineer 2. All departments, branches, and surveyors must be predefined

in the system and listed in a dropdown
Main flow: 1. Include (Login) 2. The user creates a job card for that application 3. The job card is assigned to the respective surveyor
Post conditions: 1. A notification is sent to the surveyor informing him/her that he/she has a pending job in the system 2. A job reference number is generated to uniquely identify that job 3. The status of the customer application is changed and logged

Use Case: Survey and submit survey report
ID: UC5
Brief Description: The surveyor receives the job details, prints the job card and goes to the customer's premises to survey
Actors: Surveyor
Preconditions: The job must be correctly assigned to the respective surveyor
Main flow: 1. Include (Login) 2. The user prints the job card 3. Surveys the customer premises 4. Submits the field report after survey by scanning and uploading the field report
Post conditions: 1. The job has been assigned to a plumber 2. A status log for that application is saved in the database 3. A notification is sent to the respective engineer that the field report has been submitted 4. The field report must have a customer signature 5. The status of the customer application is changed and logged
Use Case: Approve Survey report
ID: UC6

Brief Description: The user will verify and authorize the field survey report
Actors: Engineer
Preconditions: 1. A copy of the survey report must be available in the system
Main flow: 1. Include (Login) 2. Search for the customer using application number, name or date 3. Download survey report 4. Verify and authorize the report
Post conditions: 1. The copy of the survey report must have a customer signature 2. The status of the customer application is changed and logged
Use Case: Generate customer invoice
ID: UC7
Brief Description: The Engineer generates an invoice showing itemized materials and their unit cost as well as the total cost for the connection
Actors: Engineer
Preconditions: 1. The user must be logged in
Main flow: 1. Include (Login) 2. List all the materials to be used on the connection with their unit cost 3. Generate and print an invoice for the customer 4. Send the invoice to the customer via email
Post conditions: 1. The customer invoice is generated 2. A notification is sent to the Manager for authorization of the invoice 3. The status of the customer application is changed and logged

Use Case: Approve invoice
ID: UC8
Brief Description: The Manager reviews approves the invoice generates by the engineer
Actors: Engineer
Preconditions: 1. The user must be logged in
Main flow: 1. Include (Login) 2. Review the invoice 3. Approve or reject the invoice with a comment
Post conditions: 1. The customer invoice is approved 2. The status of the customer application is changed and logged

Use Case: Generate payment reference
ID: UC9
Brief Description: The FDO Officer will generate unique reference numbers against which the customer can pay either in the bank or mobile money of VISA
Actors: Front Desk Officer
Preconditions: 1. The user must be logged into the system 2. The customer invoice must have been generated and approved
Main flow: 1. Include (Login) 2. The user browses to the payments page 3. Indicates whether the customer is paying a deposit or not 4. Generates a new connection and deposit payment reference 5. Sends the payment references to the customer via email or prints them out for the customer
Post conditions: 1. The customer has a reference number against which he or she can pay for the connection

2. A notification is sent to the customer to make payments 3. The status of the customer application is changed and logged
Use Case: Make payments
ID: UC10
Brief Description: The user makes payments against the specified payment reference using his or her preferred payment channel e.g. bank or mobile money
Actors: Customer
Preconditions: 1. The customer must have the right payment reference 2. The payment reference must return the right name when queried in the payment channel system
Main flow: 1. Declare the payment reference at the bank or mobile money agent or at the utility company's cash office 2. Ensure the reference has returned the correct names 3. Make a payment 4. Receive a receipt for the payment
Post conditions: 1. The customer must receive a receipt for the payment
Use Case: Payment reconciliation
ID: UC11
Brief Description: The user reconciles all payments against an end of day statement shared by the bank or any other payment platform
Actors: Reconciliation Officer
Preconditions: 1. The payment must show in the Tracebill system 2. The payment must be on the bank statement
Main flow: 1. Include (Login) 2. Upload the bank statement 3. Reconcile payment

Post conditions: 1. The transaction status will be logged as reconciled 2. A notification shall be sent to the Head of reconciliation about reconciled payments 3. A notification is sent to the Engineer to connect the customer in the field 4. The status of the customer application is changed and logged
Use Case: Meter installation and connection
ID: UC12
Brief Description: The plumber prints out materials to be used, requests for these at the store and installs the meter at the customer's premises and charges the pipes with water
Actors: Plumber
Preconditions: 1. The materials list must be printed out 2. Any extra materials must be specified and properly documented 3. The customer invoice must be fully paid
Main flow: 1. Include (Login) 2. Print out the material list for connection 3. Make a field connection and a field report with details of the meter installed
Post conditions: 4. The customer is successfully connected 5. The status of the customer application is changed and logged
Use Case: Capture field connection report
ID: UC13
Actors: Engineer
Preconditions: The Engineer must have a detailed report from the field connection

Main flow: 1. Include (Login) 2. Input expenditure with all materials used on the connection 3. Save the details in the system
Post conditions: 1. The field connection report is submitted 2. The status of the customer application is changed and logged
Use Case: Approve field connection report
ID: UC14
Actors: Manager
Preconditions: The Manager must be able to view a detailed report from the field connection
Main flow: 1. Include (Login) 2. View details of the field report 3. Approve of reject the report with a reason
Post conditions: 1. The field connection report is approved 2. The status of the customer application is changes and logged
Use Case: Approve field connection report
ID: UC15
Actors: Billing Manager
Preconditions: The Manager must be able to view a detailed report from the field connection
Main flow: 1. Include (Login) 2. View details of the field report and ensure the information is accurate 3. Make the necessary updates on the customer account when

required 4. Indicate if the customer is prepaid or postpaid 5. Create a unique customer reference for the customer
Post conditions: 1. The customer reference number is generated 2. A notification is sent to the customer with his or her customer number 3. The status of the customer application is changed and logged

3.1.2 Use case diagram for the Readings module

Below is a use case diagram for the readings process in the TraceBill system;

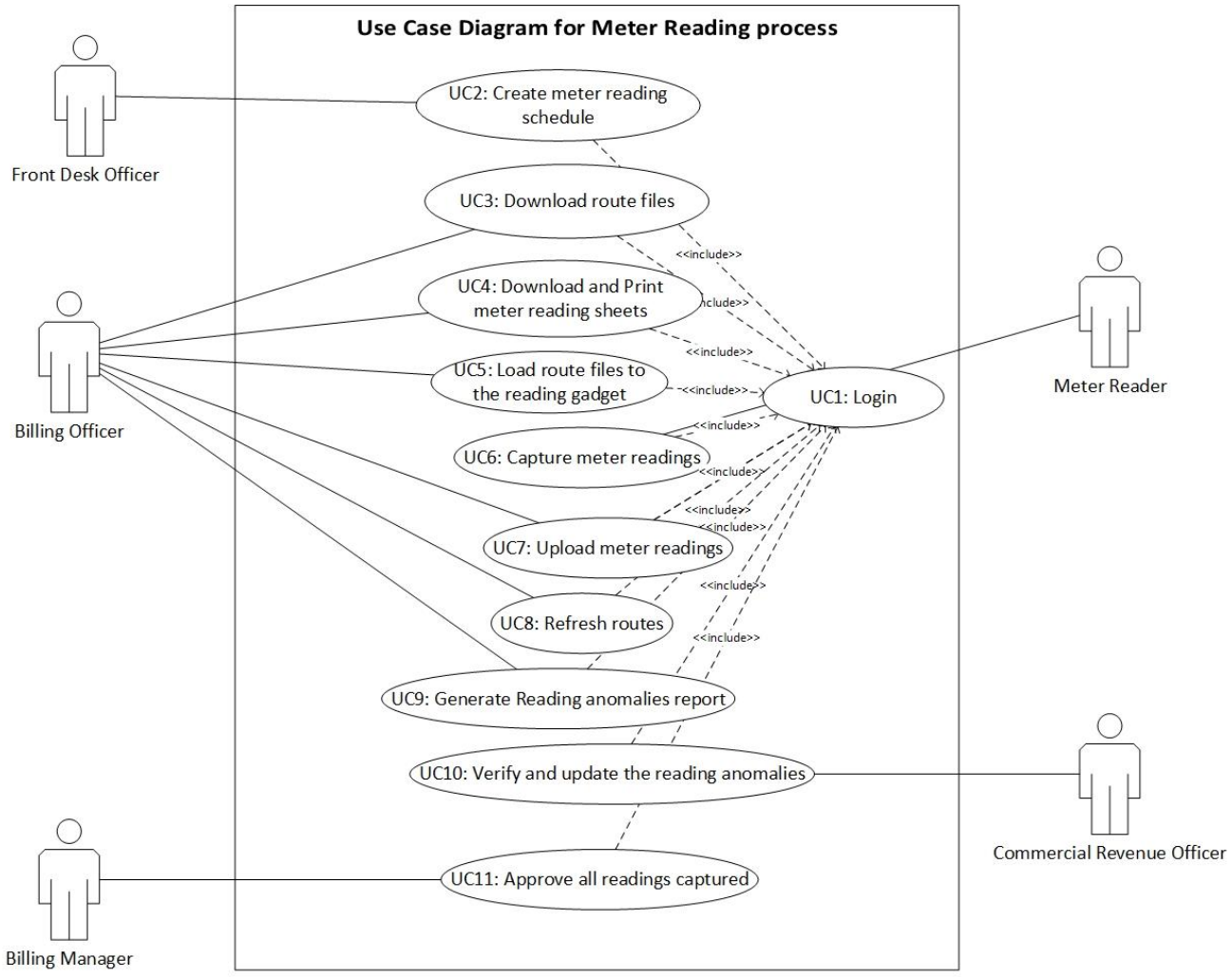

Figure 3 Meter Reading process Use Case

3.1.3 Use case diagram for the Administrator

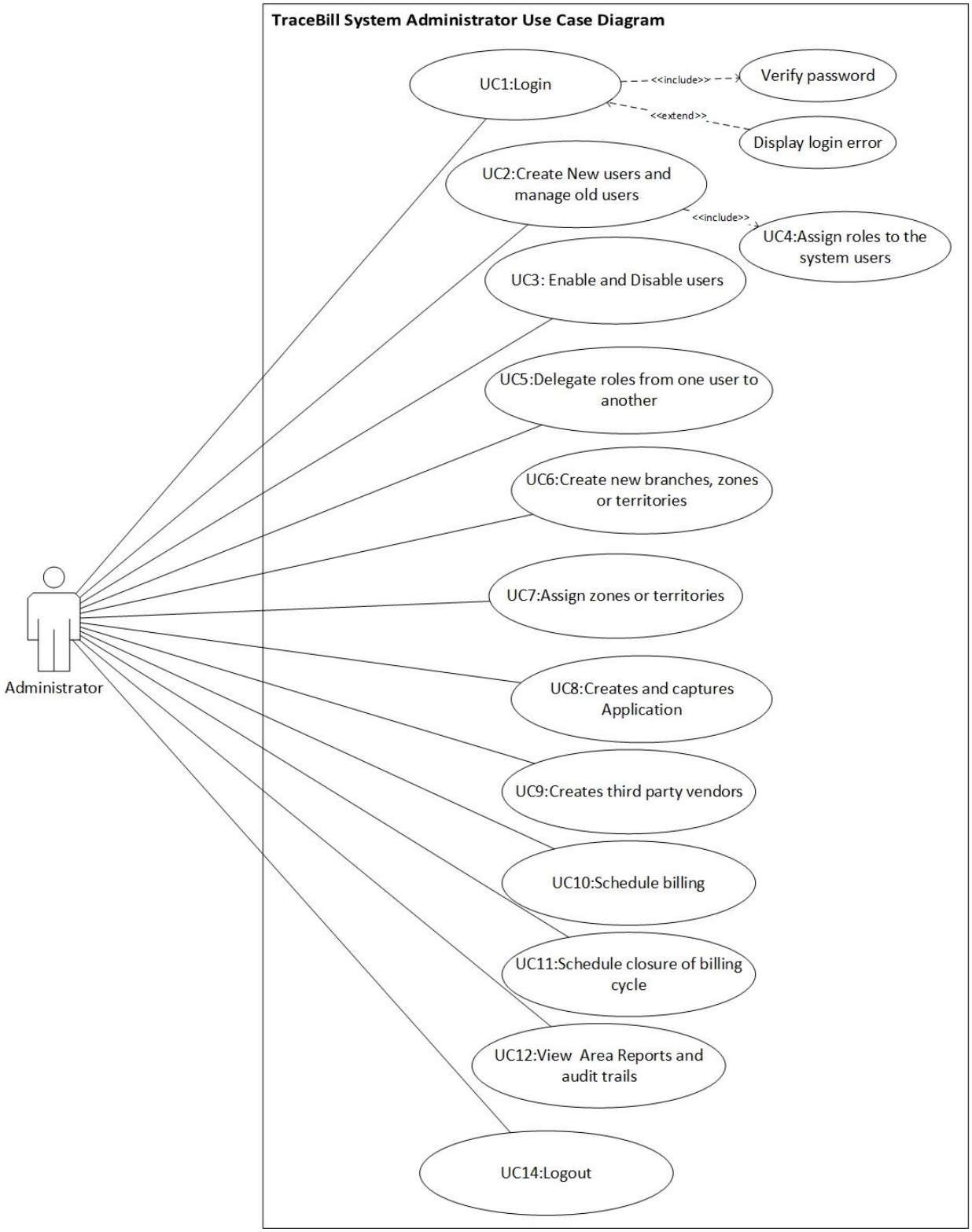

Figure 4 Administrator use case diagram

Use case specifications for the Administrator

Use Case: Login
ID: UC1
Brief Description: Sign in so as to access and use the system
Actors: Administrator
Preconditions: 3. The user has accessed the application using a browser 4. The user needs a username and password to access the system
Main flow: 5. The user enters his/her user name 6. The user enters his/her password 7. If the login details are correct 7.1. The user is allowed to access the system 8. Else 8.1. The user is denied access to the system
Post conditions: 2. Access has been granted to the user.

Use Case: Create New users and manage Old Users
ID: UC2, UC4
Brief Description: Create new users in the system.
Actors: Administrator
Preconditions: 1. The user must be logged in. 2. The user must have the user rights to be able to create users in the system
Main flow: 1. Include (Login) 2. The user inputs name, contact, email address, role and any other details pertaining the new or old user. 3. If all mandatory fields are filled in a. The new/old user is created in the system

4. Else a. The user is requested to properly fill in the form
Post conditions: 1. The new user is successfully created in the system. 2. The old/new user is enabled. 3. The old /new user is disabled. 4. Roles are assigned to old/new users. 5. The administrator delegates roles from one user to another

Use Case: Enable and Disable users
ID: UC3
Brief Description: Activate and deactivate system users to allow or deny them access to the system respectively.
Actors: Administrator
Preconditions: 1. The user must be logged in. 2. The user must have the user rights to enable and disable user accounts 3. The user details must exist in the system
Main flow: 1. Include (Login) 2. The user searches for the user by username, area or branch 3. The user clicks the activate button to activate the user 4. The user clicks the deactivate button to deactivate the user
Post conditions: 1. The user is allowed access or deactivated from the system
Use Case: Delegate roles from one user to another
ID: UC5
Brief Description: In case a certain user is away for leave or vacation, the administrator can delegate the former's system role to

another user.
Actors: Administrator
Preconditions: 1. The user must be logged in. 2. The user must have the user rights to be able to delegate roles to users in the system
Main flow: 1. Include (Login) 2. Searches for the user by name, area or branch 3. Select the user that is away on leave 4. Select the user acting in the above user's position 5. Select the start and end date period when the user will be acting 6. Select assign to transfer user rights from one user to another
Post conditions: 1. The access rights for the user on leave will be deactivated and account activated when he or she returns and logs into the system 2. The user acting will be assigned rights for the one he is relieving
Use Case: Create new branches, zones or territories
ID: UC6
Brief Description: Create new branches, zones or territories.
Actors: Administrator
Preconditions: 2. The user must be logged in. 3. The user must have the user rights to be able to create branches, zones or territories in the system
Main flow: 1. Include (Login) 2. The user inputs details pertaining the branch, zones or territories. (Fills in the respective form) 3. If all mandatory fields are filled in a. The new branch, zone or territory is created in the

system 4. Else a. The user is requested to properly fill in the form
Post conditions: 1. The new branches, zones are successfully created in the system. 2. Zones or territories are assigned to relationship managers
Use Case: Assign zones or territories
ID: UC7
Brief Description: Assign many blocks or zones to territories
Actors: Administrator
Preconditions: 1. The user must be logged in. 2. The zones or zones must exist in the system
Main flow: 1. Include (Login) 2. The user selects a number of blocks from the system 3. Assign the selected blocks to a certain territory
Post conditions: 1. Blocks are assigned to territories

Use Case: Creates and Captures Application
ID: UC8
Brief Description: Capture application details and save the application.
Actors: Administrator
Preconditions: 1. The user must be logged in. 2. There should be already defined ID types, proposed class and connection size in a dropdown list
Main flow:

1. Include (Login) 2. The user inputs the name, contact, email address, ID and location details 3. The user attaches the copies of files like ID copy, proof of ownership and passport size photos among others 4. The user saves the application
Post conditions: 1. The application is assigned a unique application ID and committed to the database 2. The customer must be given a unique payment reference number 3. The status of the customer application is changed and logged

Use Case: Creates third party Vendors
ID: UC10
Brief Description: Capture details pertaining the third-party vendors such as external contractors, banks, mobile money agents and save the details in the system
Actors: Administrator
Preconditions: 1. The user must be logged in. 2. The user must have the user rights to create third party vendors in the system.
Main flow: 1. Include (Login) 2. The user inputs the name, contact, email address and location details of the third-party vendor. 3. User inputs the type of vendor it is like contractor, bank or mobile money 4. The user saves the form
Post conditions: 5. The vendor is successfully created in the system.

Use Case: Schedule Billing
ID: UC10
Brief Description: Schedule billing of the customers according

to the selected billing criteria
Actors: Administrator
Preconditions: 1. The user must be logged in. 2. The user must have the user rights to schedule billing of customers
Main flow: 1. Include (Login) 2. Select billing criteria e.g. by branch or area or territory or individual customer 3. Set the date and time for billing
Post conditions: 1. A billing job is scheduled and progress report displayed
Use Case: Schedule closure of billing cycle
ID: UC10
Brief Description: Schedule closure of the billing cycle according to the cycle frequency e.g. monthly, weekly or quarterly
Actors: Administrator
Preconditions: 1. The user must be logged in. **2.** The user must have the user rights to close billing cycle
Main flow: 1. Include (Login) **2.** Run billing reports **3.** Check for any unbilled readings **4.** Bill all unbilled readings 5. Update all payments for that billing cycle 6. Select date and time for closing the billing cycle
Post conditions: 1. A billing cycle closure job is scheduled and progress report displayed

Use Case: View system reports and audit trails
ID: UC11
Brief Description: The user is able to extract and print all system reports and audit trails
Actors: Administrator
Preconditions: 1. The user must be logged in. 2. The user must have the user rights to view reports
Main flow: 1. Include (Login) 2. Select report parameters according to the user's preference e.g. by branch or area or territory or individual customer 3. Click search to display the report **4.** Export and print the report
Post conditions: 1. Reports are extracted and printed and circulated accordingly

3.2 Process flow

The diagram below illustrates the various processes involved in TraceBill in order to deliver a service to water utility company customers.

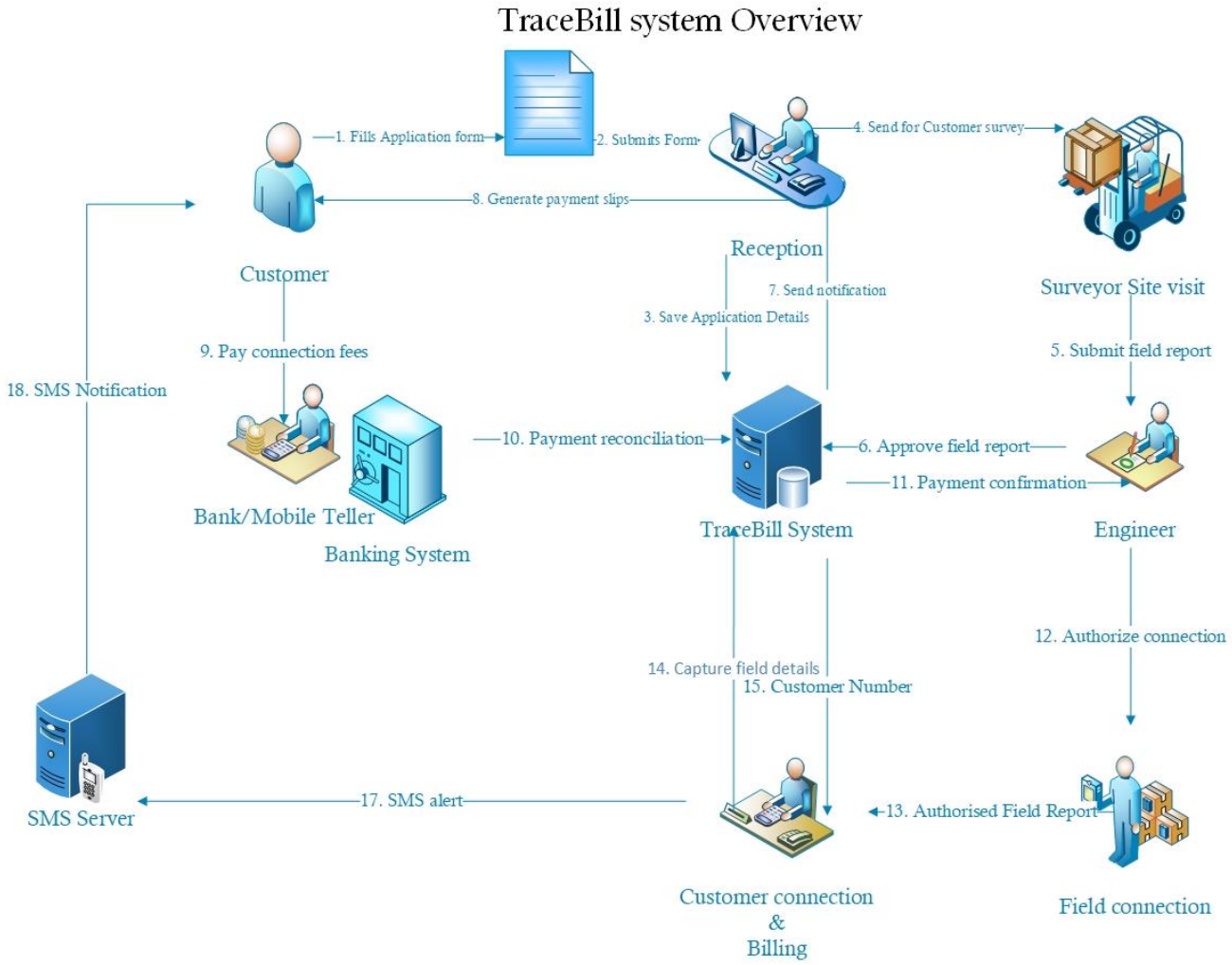

Figure 4 TraceBill system Overview

3.3 Activity diagram

An activity diagram is flowchart that represents the flow from one activity to another. The figures below describe how activities will be coordinated in the TraceBill system for the various processes to provide water and sewerage services to both to all customers of a water utility company.

3.1.1 New connection process

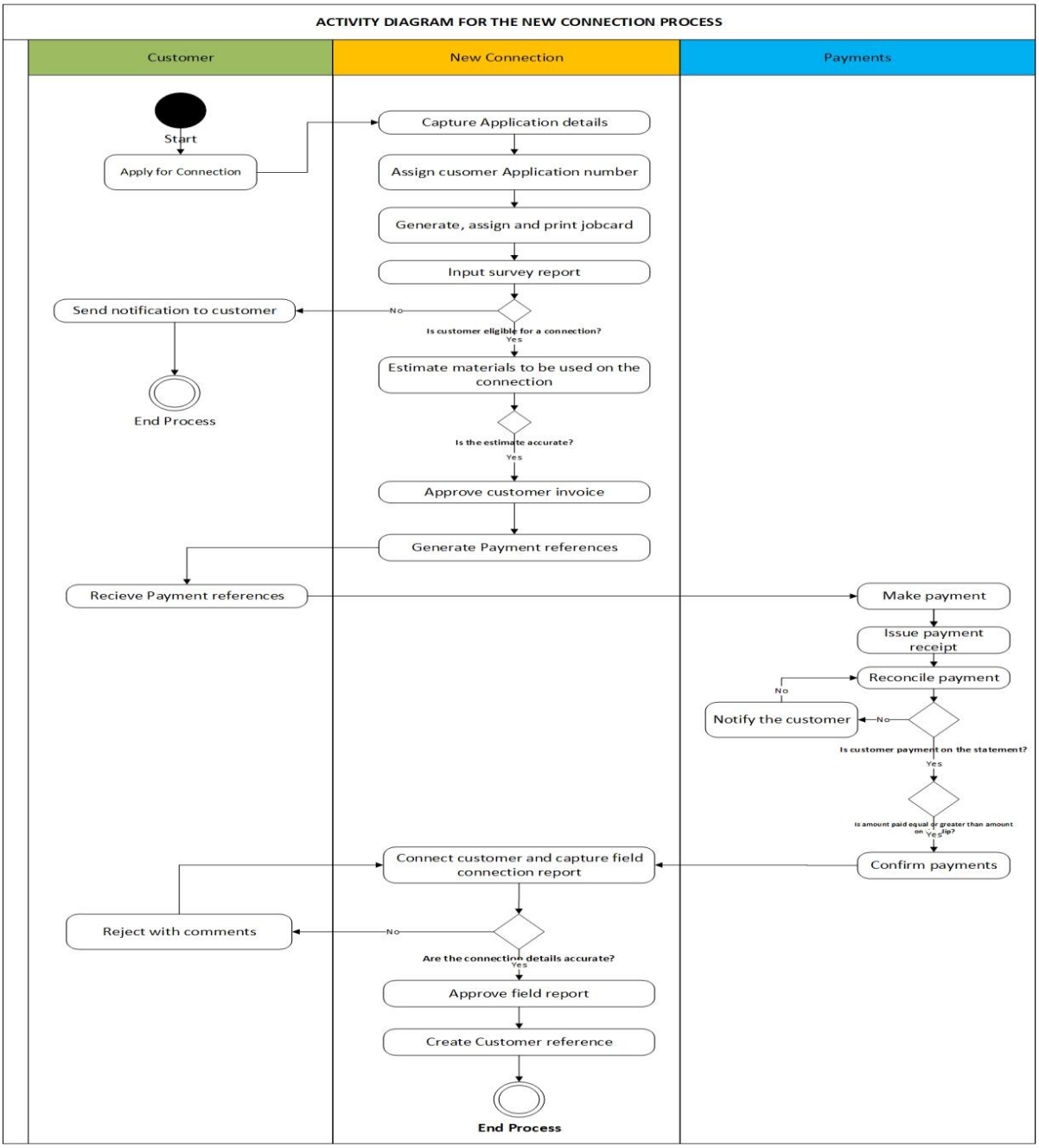

Figure 5 New connection process activity flow

3.1.2 Readings process

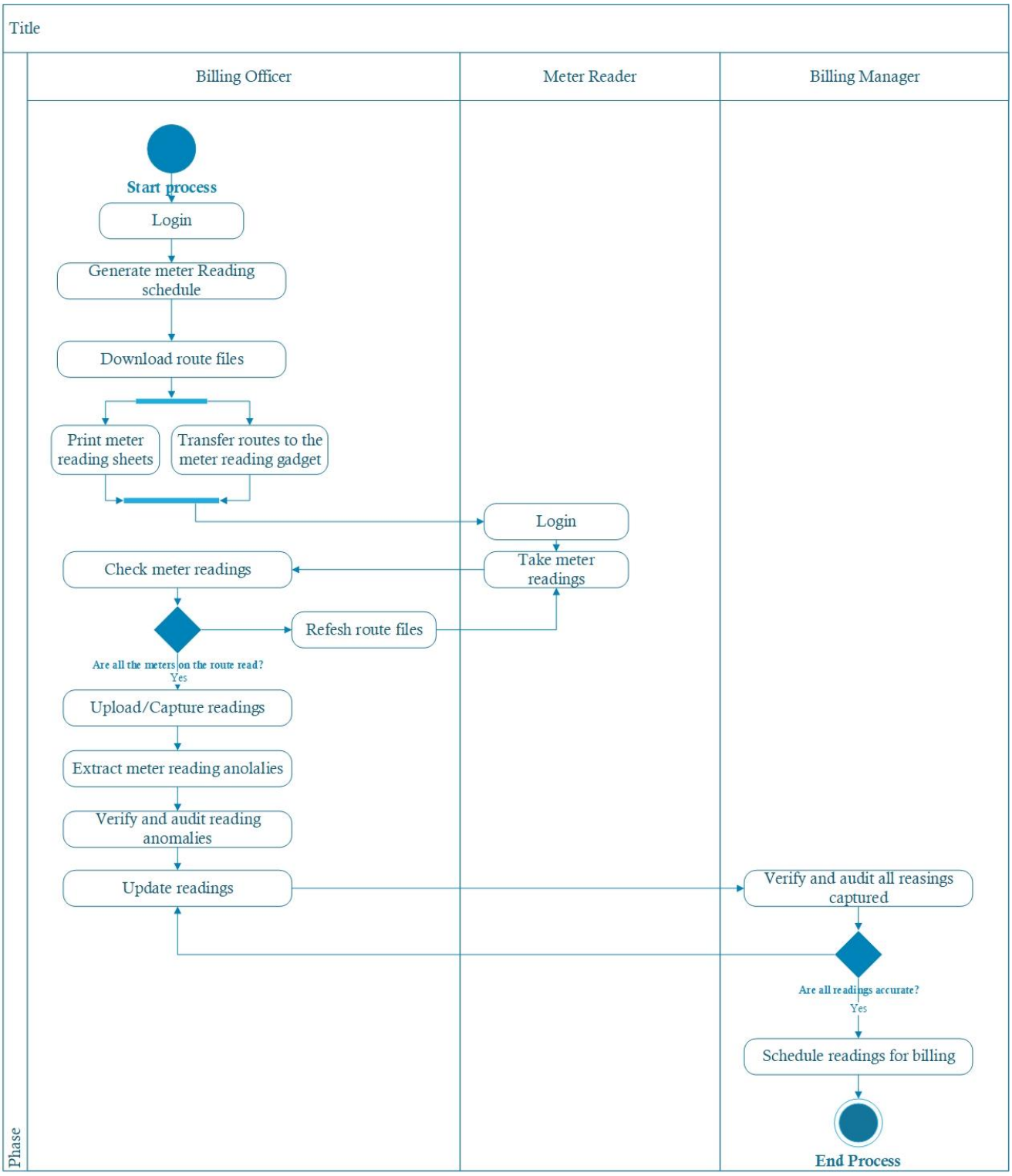

Figure 6 Reading Process activity flow

3.1.3 Billing Process

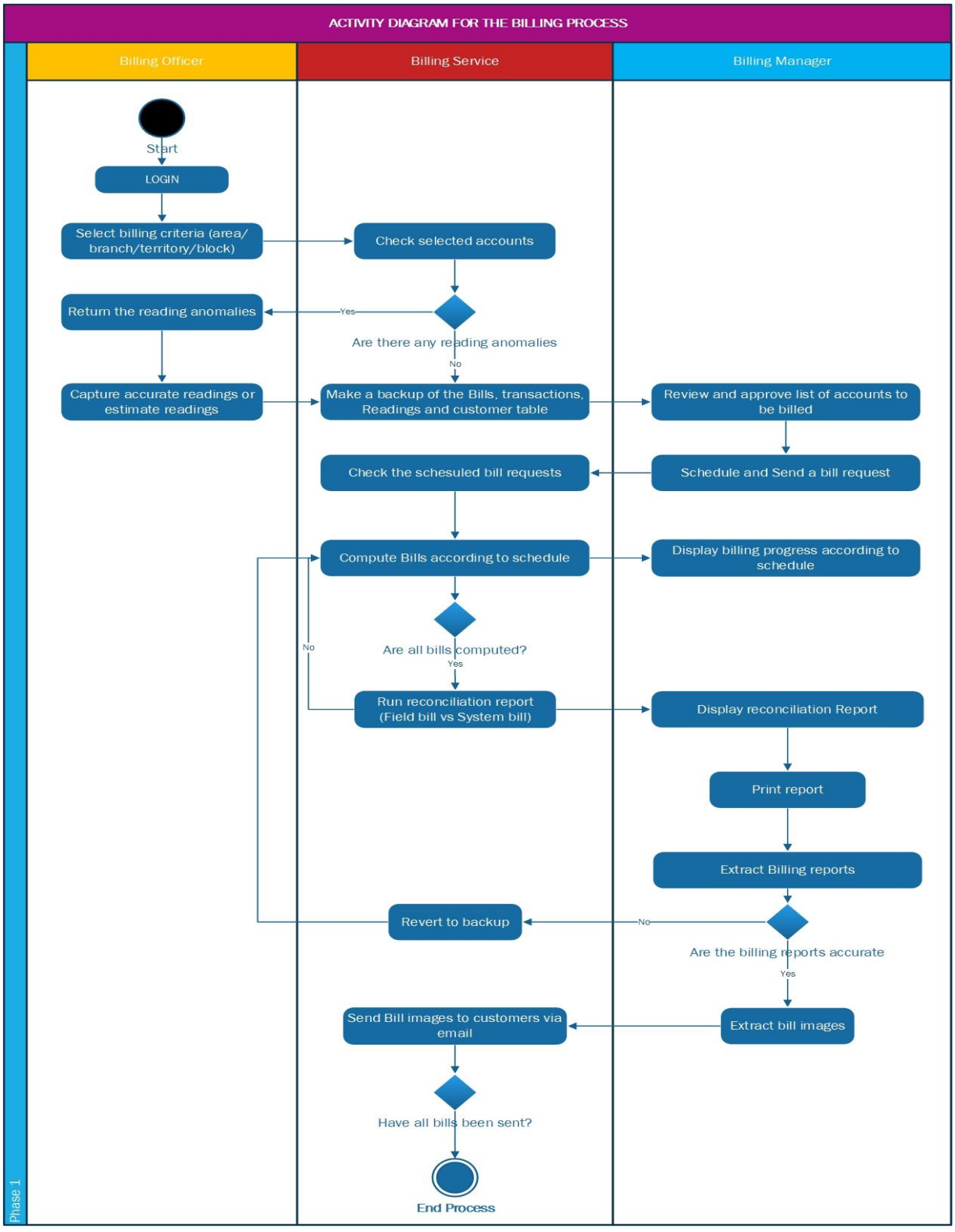

Figure 7 Billing Process activity flow

3.4 Context Diagram

This is a level 0 dataflow diagram that defines and clarifies the boundaries of the TraceBill system. It identifies the flows of information between the system and external entities. The entire software system is shown as a single process

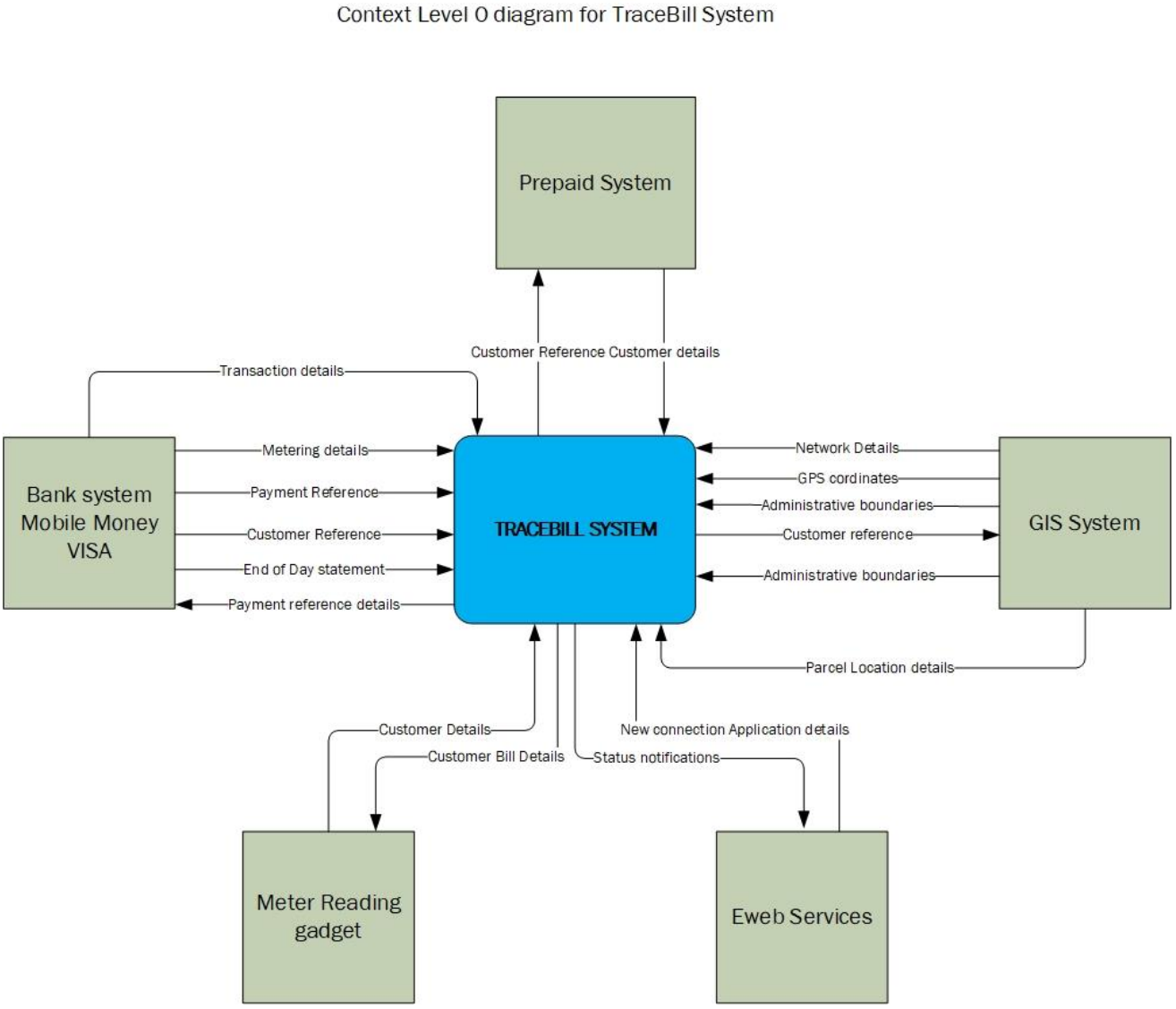

Figure 8 TraceBill Context diagram

3.5 Class diagram

This diagram describes the structure of the TraceBill system showing the system's classes, their attributes, methods and relationships among objects. There are four main classes in the proposed system for all water utility companies. These classes illustrated below show the various object interactions in the system with their attributes and methods.

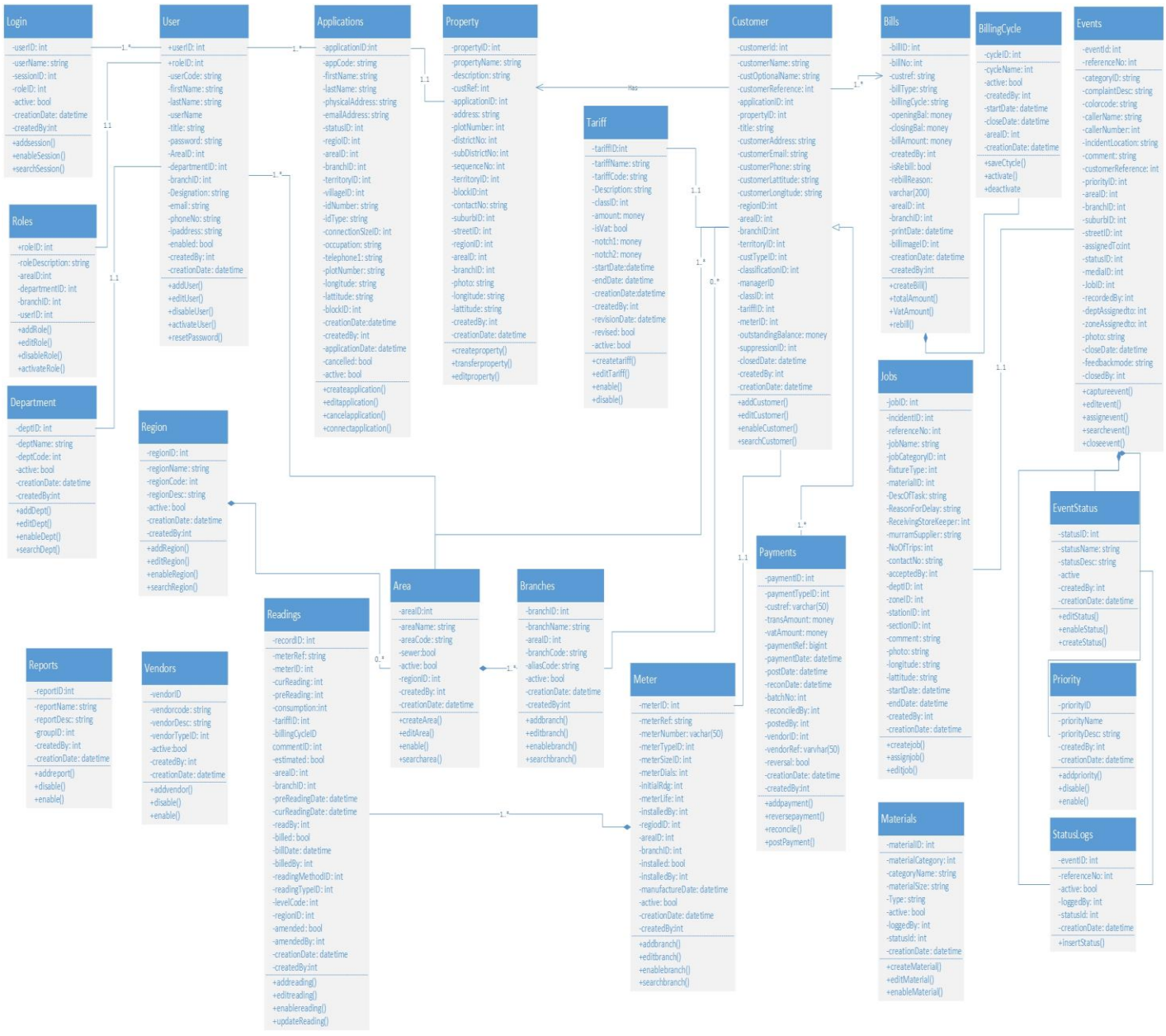

Figure 9 TraceBill Class diagram

3.6 Entity Relationship Diagram

The ERD diagram constitutes a technique for representing the logical structure of a database in a pictorial manner. This analysis is then used to organize data as a relation, normalizing relation and finally obtaining a relation database. Below is the proposed ERD for the TraceBill system;

Figure 10 Entity Relationship diagram

4. User Interfaces

4.1 Login page

This is the login page that the TraceBill users shall use to log in order to access the system. All users shall be required to input their usernames and passwords in order to use the system.