SOFTWARE AGENT TECHNOLOGY: A FRAMEWORK FOR MINIMIZING FRAUD IN POSTPAID BILLING SYSTEMS

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Abstract
The postpaid billing systems in telecommunication industry experiences some forms of revenue leakages mostly due to fraudulent activities by some employees that costs a telecommunications company a loss of between 5% and 15% of its total revenue as shown by a research, couple with the inefficiency of some human personnel like the dispatch riders who dispatch or distribute bills. In order to minimize these problems, a framework is proposed in this paper. Software Agent Technology is used by identifying some of the areas and personnel liable to fraud and inefficiency and substituting them with Software Agents. The billing personnel and customer care centre staff are downsized to 50% and 25% respectively. Agent-based Software engineering as an extension to the traditional Object-oriented Software engineering methodology was used to come up with this framework. The framework after its implementation has shown a 70% reduction in fraud, which will be used by a company to create more job opportunities by network expansion to reach about 204 different communities in one year.

Keyword: Software agent, telecommunication, postpaid billing system, fraud

Introduction
Telecommunications provide avenue for people around the world to contact one another; this can be in form of sending and receiving messages across towns, between countries, and to and from outer space. A part from sending and receiving messages, telecommunications enable people to access information instantly (Frieden, 2009).

The transmission of messages, voice or data using telephone involves conversion of different types of information such as sound, video or text into electronic or optical signals. Electronic signals are transmitted using a medium such as copper wire or carried over the air wirelessly in form of radio waves. The optical signals travel along a medium such as strands of glass fibers. This is often called optical fiber (Frieden, 2009).

Providing avenue for communication among people from one location to another is a service which will in turn attract some charges for the service delivery. It is obvious that telecommunications has touched the life of millions of people worldwide. A message that made people to travel long distance to deliver would be delivered using the telecommunications within few seconds, without having to take the risk to traveling especially on our dilapidated roads (Garko, 2008).

In this research, the postpaid billing is given a new direction by substituting some human personnel with Collaborative Software Agents to carry out some of the tasks, thereby minimizing fraud, maximizing efficiency and revenue assurance for the company.

A survey of software agent systems
Software agent technology is an area that is receiving much interest by researchers in Artificial Intelligence and Computer Science considering it as a tool that assists users in many ways, executing and controlling certain complex routine tasks. Many software agent systems have been developed in so many areas of human endeavor, some related to telecommunications network management.
(Poslad et al., 1999; Lipperts and Kreller, 1999; Stamoulis et al., 1999; Bonabeau et al., 1998). Although these previous works did not directly address the postpaid billing system in telecommunications, they would help to provide a framework within which our system could be designed and developed.

**Agent TCL**

Agent TCL is a software agent system for supporting mobile agents, the TCL means Tool Command Language. This system was developed at the Dartmouth College, USA. The Agent TCL architecture was based on the server model that was proposed by Telescript (White, 1994), while the scripting language implementation centered on the Tool Command Language form (Ousterhout, 1994; Dale, 1997).

**Advantages of the agent TCL**

- The software agents provide all the services that are available within the system immaterial of whether they are mobile or stationary.
- At each site of Agent TCL, the server always handles the management of local and incoming mobile agents.
- The server in addition, provides mechanisms for enforcing security among the agents and their communications.

The execution of agents is usually handled by the interpreter that is appropriate to the source language of software agent. Agents can be written using compiler based programming language but could not migrate due to its platform dependence (Dale, 1997).

**Telescript**

Telescript is a software agent system that is commercially available and was developed by General Magic Incorporated to support mobile agents for electronic marketplaces. The Telescript is one of the first available software agent development environments. The three major component of Telescript are

- The Architecture: this consists of places, engine, engine places, and regions.
- The Language
- The Development Environment.

For more about Telescript see (White, 1994; Dale, 1997).

**TACOMA**

TACOMA stands for Tromoso and Cornell Moving Agents. The TACOMA system was a joint project between the University of Tromoso in Norway and Cornell University in the USA (Dale, 1997). The project was primarily concerned with providing operating system support for software agents. For further readings on TACOMA see (Johansen et al., 1995; Johansen et al., 1995b; Johansen et al., 2001; Dale, 1997).

The TACOMA system architecture consists of the following:

- Sites: which represent a collection of computers and resources where agents can interact.
- Places: which represent a potentially restricted part of a site where guest agents can be executed.
- Agents: These are considered as the computational unit of the system.

In TACOMA system the agents have three potential storage mechanisms:

I. Folders
II. File Cabinets
III. Briefcase

**Other software agent systems**

There are many other agent systems that are in use today, the prominent among them are:

- Agent Process Interaction Language (APRIL), developed jointly by the Imperial College, England and Netmedia Laboratory Fujitsu, Japan (McCabe and Clark, 1995; McCabe and Clark, 1996; Dale, 1997).
- The Frankfurt Mobile Agent Infrastructure (fMAIN) developed at the Goethe-University in Germany (Lingnau et al., 1995; Lingnau et al., 1996; Dale, 1997).

**Overview of the postpaid billing system**

For many years, even before the introduction of the mobile communications in Nigeria, there were many problems associated with Nitel (Nigerian Telecommunications Ltd), which was the only telephone operator in the country. Most of the problems then were from the billing aspect of the company. The subscribers’ complaints included
wrong posting of their payments, over billing and other problems associated with the connectivity.

Problems of Postpaid Billing
(a) From the Customer’s point of view
Garko and Tijjani (2009) identify the main problems of the postpaid billing processes in relation to the customers and the companies as:
1- Wrong posting of payments to the right customer’s account.
2- Over billing.
3- Wrong meter readings.
4- Accumulation of rental charges even when the line is faulty.
5- Bills dispatch problems.
(b) From the Service Provider point of view
1- Failure for the subscribers to make payment promptly.
2- Overhead cost for employing staff in the customer care centre.
3- Cost of buying stationeries for bill printing.
4- Cost for bills distribution.
5- Open to fraud by the company’s staff.

These problems usually cause revenue leakages as a result of fraudulent activities by the human personnel that cause a telecommunication company to loss between 5% and 15% of its annual revenue, which is a huge amount of money.

Aim and objectives of the research
The aim of this research is to apply the concept of Software Agent Technology to design and develop a multi-agent architecture for minimizing fraud in postpaid billing systems. The objectives of the research are:
- Explore the diverse problems associated with the postpaid billing system that are human user centered and come up with the practical solution by substituting human users with software agents.
- To build a framework for a billing system that is efficient and beneficial to both the Telecommunications Companies and their subscribers.
- Design a framework that minimizes fraud and maximizes revenue thereby creating job opportunities to the teeming youth of this country.

Significance of the research
In today’s world of Information and Communication Technology (ICT), where the use of telephone and other communication devices become the order of the day, where the use of cell phones is becoming more common even in the third world countries Nigeria inclusive, there is a strong need for efficiency in both the service delivery and the way these services are charged by the telecommunications companies. The essence of any profit-oriented ventures like telecommunications is to always minimize cost and maximize profit. To achieve maximizing profit there is a need for efficiency in the billing system which must minimize revenue leakages and must ensure revenue assurance. This is achievable by substituting some personnel with collaborative software agents in order to minimize fraud.

Related works
Ou et al., (2007) address some of the billing problems in mobile communication technologies from the roaming aspect for a customer that travels out of his home network. A proposal was designed for the other network to charge and bill the customer instead of billing the customer’s home network that would solve the problem or dispute between the customer and his home network service provider. The customer after having access to the roaming facility, the network that provides that services should charge and bill the customer for the services s/he enjoys. However, Ou et al., (2007) only focus their research on mobile communication technologies, the landline or fixed networks are not mentioned.

Many billing problems were also highlighted by Garko and Tijjani (2009) but in that paper Code Division Multiple Access (CDMA) switches were considered and both the prepaid and postpaid were compared some possible solutions were derived from the combination of good processes of the two billing platforms, which were not sufficient.

Stratus (2010) in one of their product called Emerging Networks Telecommunications Infrastructure Control Environment (ENTICE) proposes a solution to some of the billing in telecommunications. ENTICE combines order processing, service activation, account
management and customer support with real-time authentication and rating to create all-in-one solution for prepaid/postpaid applications. What ENTICE is doing is just like a convergent billing system by combining the postpaid and prepaid applications in one place. 

Mills (2002) observed that it is very common for telecommunication companies to lose from 5% to 15% of total revenue per year, if care is not taken on the revenue leakages. Mills (2002) highlighted many problems among which he mentioned about “Fraud”.

Another software Vendor that specializes in the design and development of billing systems, Zygo (2010), in one of their latest products “New Generation Billing & Customer Care System” proposes architecture of the billing system to be:

![Figure 1 Zygo’s Telecommunications Billing Architecture (Zygo, 2010)](image)

Even though, as claimed by Zygo (2010) that, their product is very beneficial to the telecommunications company from the diagram, it can be seen that, many people (users) are involved in the day-to-day running of the system. This would of course, expose it to various form of revenue leakages as unnecessary delays and fraudulent activities are likely to go on in the system. In order for the system to have all the listed benefits, there is a need to employ Software Agents to take over some of the critical processes to maximize revenue assurance and minimize revenue leakages and fraudulent activities. This will in turn maximize the overall efficiency of the billing processes in particular, and the Telecommunications Company in general.

Billing and the problem of revenue leakages

It is very common for telecommunications companies to lose between 5% and 15% of the total revenue annually, if care is not taken on the various avenues of revenue leakages (Mills, 2002). Mills (2002) identified some of the causes of revenue leakages as:

- Provisioning
- Incomplete records
- Trouble tickets / repair
- Customer refunds
- Call Detail Records
- Collections
- Fraud

most of these problems are man-made that can be avoided or minimized when humans are substituted with Collaborative Software Agents.

Methodology

In this chapter the entire billing system is decomposed into three sub-systems, with each sub-system representing one of the three activities performed in a typical postpaid billing system. We studied the problem of each sub-system and proposed a technique for solving the problem using the software agent technology. Finally, the security threats of the software agents are explored and solutions proffered.

Proposed pre-billing activities using software agents

These are the routine tasks executed in the billing system before the actual bills generation is commenced. Some of these activities include:

- **Data origination**: The billing data originates from the time a link is established between two (2) subscribers using mobile stations (handsets).
- **Data transmission**: The billing data after origination then is transmitted through the BTS, to the BSC and finally to the MSC where it is recorded as a CDR.

Parallel distributed data processing

On a typical telecommunications network the data origination and transmission usually involve thousands or even millions of subscribers at a particular time. The origination of the billing data and its transmission to the MSC are done
concurrently (in parallel), just resembling a typical neural network activity.

**Parallel distributed processing using ANN**

The entire telecommunications network together with its activities and architectures has so much resemblance with Artificial Neural Network (ANN). Considering the human neural network for example, neurons are located all over our body and they collect and send data from where they are located to the brain where the data is processed centrally, after which the output is generated and communicated to the right actuator for the appropriate action to be taken.

**Handling the billing activities by software agents**

In order to have more efficiency, the problem to be solved by the software agents in the billing activity is partitioned into smaller components or subproblems; each component is solved by a particular agent or group of agents. Solving the problem by a group of agents introduces the need for communication among the software agents.

In solving the problem in this manner, we borrowed some ideas from Parallel Computing, there is a procedure called PCAM – which means Partitioning, Communication, Agglomeration, and Mapping.

![Figure 2 problem decomposition into sub-problems](image)

By employing the PCAM algorithm or procedure, the speed and efficiency is improved in solving or carrying out the billing activity by the software agents.

**Agent-oriented modeling method – some assumptions**

When modeling a real world application domain using agent-oriented approach the following assumptions are made:

- Agents and objects can co-exist and have mutual relationship.
- An active object can be regarded as an agent.
- Agents act asynchronously.
- Interactions among the software agents take place through exchanging messages.

**Design of agent places on the proposed system**

The processes involved in bills generation to distribution include the three (3) main processes highlighted earlier: The Pre-billing, the main billing, and the Post-billing processes. Each of these processes is having some sub-processes that are taking place concurrently, and mostly on the same or different servers. The agents involved in these processes execute their jobs on their various servers (computer system). The places are simply the execution environments for these agents on the servers they are located. What the places provide to their residing agents is the services offered by the host machine that is accommodating the software agents.

The `java.lang.Runnable` interface is used to extend the place abstract class; this is in order to ensure concurrent job execution by the software agents residing within a particular machine. The services provided or offered by the host machine connect to the agent execution environment (place). The main
services explored by the agents in our own case are the file transmission and database access. In our proposed system, five (5) different places are used to serve as execution environments for the five different software agents we have. These are:

- PayProcessingPlace
- CDRProcessingPlace
- BillGenerationPlace
- ReportGenerationPlace
- BillDistributionPlace

The UML class diagram for the software agent places is shown in figure 3

![UML class diagram]

**System implementation**

Having come up with the various designs of the components of our proposed system, for the results to be obtained and evaluated, the designs were implemented. In the implementation stage, client-server network architecture was used with four computer systems, one system as the server, while the remaining three as the clients or workstations.

Software agents reside on both clients and the server depending on the functionality of the agent. Payprocessor and CDRprocessor reside on the clients, while BillGenerator, ReportGenerator, and BillDispatcher reside on the server. Java was used to implement the agent system designs, while Visual Basic 6.0 was used to implement all the processes; in addition, Mysql was used as our backend and php as the scripting language used to implement the web-based customer settlement portal.

**System requirements**

In carrying out the system implementation, some components in form of hardware and software were required. The experimental environment used was comprised of a local area network (LAN) with four computer systems. The following are what we considered to be the minimum requirements as far as the billing system is concerned, considering the volume of data that is involved in billing activities.

**Software requirements**

Having highlighted on the hardware requirements of our new system the remaining component that manipulates the hardware is the software. The software requirements for our new system are as follows:

- Java programming language : J2SE 1.6 was used to implement the agent system
- Visual Basic 6.0 was used to implement almost all the processes
from CDR and payment processing to bills generation and distribution.

- Mysql RDBMS was used as our back-end to develop and manage all our database tables
- Macromedia Dreamweaver and PHP scripting language were used together with Mysql and Apache to implement the customer settlement portal.

**System development**

This involved setting up the components highlighted above in form of LAN and writing codes to implement the various designs and algorithms in our new system. As mentioned earlier, Mysql 5.0 was used as a relational database management system (RDBMS) to house the various database tables.

**Results and discussion**

After coming up with the results of implementing our framework, we tried to compare them with what is currently obtained or practiced in some four randomly selected telecommunication companies in Nigeria. The comparisons are shown in some tables and graphs under this section of the thesis.

The results revealed the advantage of implementing our proposed framework as it will help a telecommunication company in minimizing fraud as the billing personnel are reduced to half (50%), Customer service centre staff reduced to one quarter (25%), and also maximizes revenue by the same factor and improves efficiency in the overall operations in the postpaid billing system. The telecommunication companies are named: Company 1, Company 2, Company 3, and Company 4. Our framework is represented as “Agent_based” on the various tables and graphs that follow.

**Company 1 and agent_based framework compared:**

The following tables are drawn from the data obtained by interviewing some billing personnel and compared the data with our results from the Agent_based framework.

**Table 1:** Human and Material Resources Requirements for the Company 1

Gregory Maksha Wajiga
From the table 1 above it can be seen that the requirements for Company 1 is more than that of our framework, this means more money is spent in Company 1 by paying huge sum of money for salaries and purchase and maintenance of some required items.

Table 2: Monthly Salaries and Allowances for the Company

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty</th>
<th>Rate</th>
<th>Amount</th>
<th>Amount</th>
<th>Agent_based</th>
<th>Agent_based</th>
</tr>
</thead>
<tbody>
<tr>
<td>Billing Staff</td>
<td>200</td>
<td>70000</td>
<td>14,000,000.00</td>
<td>7,000,000.00</td>
<td>7,000,000.00</td>
<td></td>
</tr>
<tr>
<td>Customer C. Staff</td>
<td>400</td>
<td>70000</td>
<td>28,000,000.00</td>
<td>7,000,000.00</td>
<td>21,000,000.00</td>
<td></td>
</tr>
<tr>
<td>Dispatch Rider</td>
<td>72</td>
<td>35000</td>
<td>2,520,000.00</td>
<td>0.00</td>
<td>2,520,000.00</td>
<td></td>
</tr>
<tr>
<td>Staff Training</td>
<td>200</td>
<td>300000</td>
<td>5,000,000.00</td>
<td>2,500,000.00</td>
<td>2,500,000.00</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>49,520,000.00</strong></td>
<td><strong>16,500,000.00</strong></td>
<td><strong>33,020,000.00</strong></td>
<td></td>
</tr>
</tbody>
</table>

From table 2, it can be seen clearly that currently company 1 pays huge amount as monthly salaries and allowances. By implementing our framework, the company will minimize this spending by almost 60% as can be seen by comparing the column “Amount” and column “Agent_based”. The gain of implementing our framework by company 1 is clearly shown on the same table in column “Difference”.

Table 3: Monthly Overhead Cost of Company 1

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty</th>
<th>Rate</th>
<th>Amount</th>
<th>Amount</th>
<th>Agent_based</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Maintenance</td>
<td>12</td>
<td>10,000.00</td>
<td>120,000.00</td>
<td>60,000.00</td>
<td>60,000.00</td>
<td></td>
</tr>
<tr>
<td>Fuel</td>
<td>12</td>
<td>20,000.00</td>
<td>240,000.00</td>
<td>120,000.00</td>
<td>120,000.00</td>
<td></td>
</tr>
<tr>
<td>Printer Cartridge</td>
<td>200</td>
<td>15,000.00</td>
<td>3,000,000.00</td>
<td>0.00</td>
<td>3,000,000.00</td>
<td></td>
</tr>
<tr>
<td>Bill Paper</td>
<td>250</td>
<td>1,000.00</td>
<td>250,000.00</td>
<td>0.00</td>
<td>250,000.00</td>
<td></td>
</tr>
<tr>
<td>Report Paper</td>
<td>100</td>
<td>1,000.00</td>
<td>100,000.00</td>
<td>0.00</td>
<td>100,000.00</td>
<td></td>
</tr>
<tr>
<td>Bill Transfer to TT</td>
<td>14</td>
<td>10,000.00</td>
<td>140,000.00</td>
<td>0.00</td>
<td>140,000.00</td>
<td></td>
</tr>
<tr>
<td>Motorcycle Maint.</td>
<td>72</td>
<td>2,000.00</td>
<td>144,000.00</td>
<td>0.00</td>
<td>144,000.00</td>
<td></td>
</tr>
<tr>
<td>Motorcycle Fuel</td>
<td>72</td>
<td>5,000.00</td>
<td>360,000.00</td>
<td>0.00</td>
<td>360,000.00</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>4,354,000.00</strong></td>
<td><strong>180,000.00</strong></td>
<td><strong>4,174,000.00</strong></td>
<td></td>
</tr>
</tbody>
</table>

The company 1 as can be seen in table 3 requires some items to print and distribute bills, that cost the company huge amount. Implementing our framework where the operations are purely electronic (paperless) and does not require the services of dispatch riders as bills are posted to email addresses by software agents, only very meager amount is required by the company as monthly overhead cost for billing department.
Figure 5: Monthly expenditure difference for Company 1
The graph (Chart) in figure 5 is plotted from a table of values that summarizes the expenditure of company 1 in terms of salaries, allowances, and overhead cost spent monthly. The current company’s expenditure monthly is compared with the monthly expenditure if the company changes its postpaid billing system mode of operation to our framework. As can be seen clearly from figure 5, implementing our framework will cost the company less than half of what is spending monthly.

Company 2 and agent_based framework compared
Table 4: Company 2 Monthly Savings using Agent_based Framework

<table>
<thead>
<tr>
<th>Item</th>
<th>Company 2</th>
<th>Agent_based</th>
<th>Difference</th>
<th>Percentage Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries and Allowances</td>
<td>13,083,333.33</td>
<td>4,791,666.67</td>
<td>8,291,666.66</td>
<td>63.38</td>
</tr>
<tr>
<td>Overhead Cost</td>
<td>1,820,000.00</td>
<td>360,000.00</td>
<td>1,460,000.00</td>
<td>80.22</td>
</tr>
<tr>
<td>Total</td>
<td>14,903,333.33</td>
<td>5,151,666.67</td>
<td>9,751,666.66</td>
<td>65.43</td>
</tr>
</tbody>
</table>

Table 4 is the summary of the monthly expenditure of company 2, which shows almost 65% of the current amount is going to be saved by implementing the Agent_based framework.

Company 3 and agent_based framework compared
Table 5: company 3 monthly savings using agent_based framework

<table>
<thead>
<tr>
<th>Item</th>
<th>Company 3</th>
<th>Agent_based</th>
<th>Difference</th>
<th>Percentage Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries and Allowances</td>
<td>9,083,333.33</td>
<td>3,291,666.67</td>
<td>5,791,666.66</td>
<td>63.76</td>
</tr>
<tr>
<td>Overhead Cost</td>
<td>950,000.00</td>
<td>150,000.00</td>
<td>800,000.00</td>
<td>84.21</td>
</tr>
<tr>
<td>Total</td>
<td>10,033,333.33</td>
<td>3,441,666.67</td>
<td>6,591,666.66</td>
<td>65.70</td>
</tr>
</tbody>
</table>

Similarly, comparing our framework with company 3’s mode of operations and cost implications on monthly basis reveals 65% gain using our framework. Only 35% of the current expenditure on bills generation, printing, and distribution is going to be spent by implementing our Agent_based framework.

Company 4 and agent_based framework compared
Table 6: company 4 monthly savings using agent_based framework

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In summary, company 4 implementing our framework will minimize its spending by 62.44% salaries and allowances, 77.78% Overhead cost and generally, the company will minimize its monthly expenditure by 62.77%.

Substituting some personnel with software agents

Some billing personnel and customer care centre staff according to our proposed framework are going to be reduced to minimize expenditure, minimize fraud, and maximize revenue for a telecommunication company. The graphs below summarize the implications of reducing the number of billing personnel to 50% and customer care centre staff to 25%.

Figure 6 Monthly Expenditure for the four Companies

Minimizing fraud by implementing the agent_based framework

Fraud as one of the elements causing revenue leakages that may result a loss of between 5% and 15% of Telecommunication Company’s revenue annually, according to Mills (2002), will be minimized by implementing our proposed framework. According to Mills (2002), the likely areas exposed to fraud are:

i. CDR handling / processing by human personnel
ii. Payment in banks
iii. Billing personnel
iv. Customer care centre

If Fraud F is a function of these four areas then,

\[ F_1 \propto x, \text{ where } x \text{ is number of personnel handling CDR} \]
\[ F_2 \propto y, \text{ where } y \text{ is number of banks involved} \]
\[ F_3 \propto b, \text{ where } b \text{ is number of billing personnel} \]
\[ F_4 \propto c, \text{ where } c \text{ is number of customer care centre personnel} \]

Then, \( F_1 = Kx \), where \( K \) is constant
\( F_2 = Ky \), where \( K \) is constant
\( F_3 = Kb \), where \( K \) is constant
\( F_4 = Kc \), where \( K \) is constant

The total fraud on the system now is

\[ \text{Fraud}_1 = \sum_{i=1}^{n} f_n = K(x + y + b + c) \]

\[ \text{------------------------ (1)} \]

If \( K = 1 \), then

<table>
<thead>
<tr>
<th>Item</th>
<th>Company 4</th>
<th>Agent_based</th>
<th>Difference</th>
<th>Percentage Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries and Allowances</td>
<td>16,083,333.33</td>
<td>6,041,666.67</td>
<td>10,041,666.66</td>
<td>62.44</td>
</tr>
<tr>
<td>Overhead Cost</td>
<td>360,000.00</td>
<td>80,000.00</td>
<td>280,000.00</td>
<td>77.78</td>
</tr>
<tr>
<td>Total</td>
<td>16,443,333.33</td>
<td>6,121,666.67</td>
<td>10,321,666.66</td>
<td>62.77</td>
</tr>
</tbody>
</table>
Equation (2) is the Fraud in the currently executing environment for the four companies we are dealing with.

For our proposed framework, CDR is handled purely by software agents, payments are done purely by customers using recharge vouchers or ATM card, and we have the following:

\[ x = 0, \quad y = 0, \quad b = \frac{b}{2}, \quad \text{and} \quad c = \frac{c}{4} \]

Therefore,

\[ \text{Fraud}_2 = \frac{b + c}{4} \]

\[ = \frac{2b + c}{4} \]

Assuming 10% of billing staff handle CDR

Assuming the twenty five banks are involved in bill settlements.

**For company 1:**

Then, we have

\[ x = 20, \quad y = 25, \quad b = 200, \quad \text{and} \quad c = 400 \]

\[ \text{Fraud}_1 = 20 + 25 + 200 + 400 \]

\[ = 645 \]

\[ \text{Fraud}_2 = \frac{(2 \times 200) + 400}{4} \]

\[ = \frac{(400 + 400)}{4} \]

\[ = \frac{800}{4} \]

\[ = 200 \]

The difference between the two now gives

\[ \text{Difference} = 645 - 200 \]

\[ = 445 \]

The percentage difference \( = \frac{445}{645} \times 100 \)

\[ = 70\% \]

So, going by this means company 1 will minimize fraud by 70% if it implements our framework.

**For company 2:**

\[ x = 5, \quad y = 25, \quad b = 50, \quad \text{and} \quad c = 100 \]

\[ \text{Fraud}_1 = 5 + 25 + 50 + 100 \]

\[ = 80 + 100 \]

\[ = 180 \]

\[ \text{Fraud}_2 = \frac{(2 \times 50) + 100}{4} \]

\[ = \frac{(100 + 100)}{4} \]

\[ = \frac{200}{4} \]

\[ = 50 \]

\[ \text{Difference} = 180 - 50 \]

\[ = 130 \]

Percentage difference \( = \frac{130}{180} \times 100 \)

\[ = 72\% \]

**For company 3:**

\[ x = 7, \quad y = 25, \quad b = 70, \quad \text{and} \quad c = 100 \]

\[ \text{Fraud}_1 = 7 + 25 + 70 + 100 \]

\[ = 102 + 100 \]

\[ = 202 \]

\[ \text{Fraud}_2 = \frac{(2 \times 70 + 100)}{4} \]

\[ = \frac{(140 + 100)}{4} \]

\[ = \frac{240}{4} \]

\[ = 60 \]

\[ \text{Difference} = 202 - 60 \]

\[ = 142 \]

Percentage difference \( = \frac{142}{202} \times 100 \)

\[ = 70\% \]

**For company 4:**

\[ x = 5, \quad y = 25, \quad b = 50, \quad \text{and} \quad c = 100 \]

\[ \text{Fraud}_1 = 5 + 25 + 50 + 100 \]

\[ = 80 + 100 \]

\[ = 180 \]

\[ \text{Fraud}_2 = \frac{(2 \times 50) + 100}{4} \]

\[ = \frac{(100 + 100)}{4} \]

\[ = \frac{200}{4} \]

\[ = 50 \]

\[ \text{Difference} = 180 - 50 \]

\[ = 130 \]

Percentage difference \( = \frac{130}{180} \times 100 \)

\[ = 72\% \]

From the above simple computations we can say if our framework is carefully implemented, fraud as one of the causes of revenue leakages is going to be minimized by about 70%.

**Conclusion**

In conclusion, it can be seen that the new framework proposed and developed, that is, application of software agent technology in building a postpaid billing system in telecommunications, if properly implemented will result in minimizing fraud, minimizing expenditure and also minimizing inefficiency. By minimizing these three factors, profit and revenue are going to be maximized; while fraud is minimized by at least 70%.

**References**


