A UNIVERSAL ELECTRONIC PAYMENT MODEL IN ZIMBABWE INTEGRATING WITH SMALL AND MEDIUM ENTERPRISES AND WORKING WITH MOBILE DATABASES.

By

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Electronic payment systems are proliferating in banking, retail in government and everywhere money needs to be exchanged. Electronic payment systems are the everyday technology under use, they are the relevant systems which go hand in hand with technology and they are also high in demand. All these issues enlighten a need to design and implement an electronic payment system that addresses the specific requirements for the Zimbabwean market. An effective and universal electronic payment system in Zimbabwe can solve some problems which are currently encountered in e-commerce, thus we designed a light weight electronic payment model, universal and offering better integration to banks, all merchants and Small and Medium Enterprises. It is comprised of attributes which any electronic payment system is expected to have. It has its own security features especially the offline authentication method and other security aspects which are currently in use by banks. The integrated architectural view of the model makes it a possible solution to some current problems. This model creates a pathway for an ideal full implementation of an electronic payment system. We compared our model with the existing electronic payment systems in Zimbabwe. We realized that our model compares fairly with the existing models.
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Above all I want to give thanks to the LORD, the one who gave life, time, wisdom, intelligence and understanding freely. I want to thank Him for His love.

1 chronicles 22:12

Only the LORD gives thee wisdom and understanding.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Listing</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST OF TABLES</td>
<td>6</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>7</td>
</tr>
<tr>
<td>CHAPTER ONE-INTRODUCTION</td>
<td>7</td>
</tr>
<tr>
<td>1.1 Background</td>
<td>9</td>
</tr>
<tr>
<td>1.2 Research Focus</td>
<td>10</td>
</tr>
<tr>
<td>1.3 Aims and Objectives</td>
<td>10</td>
</tr>
<tr>
<td>CHAPTER TWO-LITERATURE REVIEW</td>
<td>11</td>
</tr>
<tr>
<td>2.1 Introduction</td>
<td>11</td>
</tr>
<tr>
<td>2.1 Classification of e-Payment Systems</td>
<td>12</td>
</tr>
<tr>
<td>2.1.1 Online credit card payment systems</td>
<td>13</td>
</tr>
<tr>
<td>2.1.2 Online electronic cash system</td>
<td>13</td>
</tr>
<tr>
<td>2.1.3 Electronic cheque</td>
<td>14</td>
</tr>
<tr>
<td>2.1.4 Smart cards based electronic payment system</td>
<td>15</td>
</tr>
<tr>
<td>2.2 Payment Instruments</td>
<td>15</td>
</tr>
<tr>
<td>2.3 Participants in e-Payment System</td>
<td>15</td>
</tr>
<tr>
<td>2.4 Present e-Payments</td>
<td>17</td>
</tr>
<tr>
<td>2.5 Existing E-Payment Models</td>
<td>20</td>
</tr>
<tr>
<td>2.6 Limitations of Present e-Payments Systems and Working Models</td>
<td>22</td>
</tr>
<tr>
<td>2.7 E-Payment Systems in Zimbabwe</td>
<td>23</td>
</tr>
<tr>
<td>2.8 Mobile Databases</td>
<td>24</td>
</tr>
<tr>
<td>2.8.1 Need for mobile databases</td>
<td>24</td>
</tr>
<tr>
<td>2.9 Proposed E-Payment System Model</td>
<td>24</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 2: Comparing the attributes of our model to eTranzact and Balasore models .................. 67

Table 3: Performance comparison of our model to eTranzact and Balasore models ................. 68
**LIST OF FIGURES**

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>the e-payment system structure (RICHARD HIGHLFIELD, 2002)</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>Generic Model of a Payment System</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>Balasore The model (1SABYASACHI PATTNAIK, 2PARTHA PRATIM GHOSH, 3AJAY KUMAR BHARTI, 2005 - 2010)</td>
<td>21</td>
</tr>
<tr>
<td>5</td>
<td>UEPS model</td>
<td>33</td>
</tr>
<tr>
<td>7</td>
<td>The sequence diagram of the UEPS model</td>
<td>35</td>
</tr>
<tr>
<td>8</td>
<td>Log in form</td>
<td>36</td>
</tr>
<tr>
<td>9</td>
<td>Buyer’s registration form</td>
<td>38</td>
</tr>
<tr>
<td>10</td>
<td>Seller’s registration form</td>
<td>40</td>
</tr>
<tr>
<td>11</td>
<td>Seller’s registration form 2</td>
<td>42</td>
</tr>
<tr>
<td>12</td>
<td>The starter page</td>
<td>45</td>
</tr>
<tr>
<td>13</td>
<td>Buyer use case</td>
<td>47</td>
</tr>
<tr>
<td>14</td>
<td>Updating buyer’s information</td>
<td>50</td>
</tr>
<tr>
<td>15</td>
<td>A typical credit card</td>
<td>52</td>
</tr>
<tr>
<td>16</td>
<td>shopping cart</td>
<td>54</td>
</tr>
<tr>
<td>17</td>
<td>The buyer enter the credit card number</td>
<td>57</td>
</tr>
<tr>
<td>18</td>
<td>The inbox</td>
<td>59</td>
</tr>
<tr>
<td>19</td>
<td>The sent box</td>
<td>60</td>
</tr>
<tr>
<td>20</td>
<td>The ozekimessageout</td>
<td>61</td>
</tr>
<tr>
<td>21</td>
<td>Buyer database</td>
<td>64</td>
</tr>
<tr>
<td>22</td>
<td>Merchants database</td>
<td>64</td>
</tr>
</tbody>
</table>
CHAPTER ONE-INTRODUCTION

Information and Communication Technologies (ICTs) have been adopted widely around the world in recent times. In Zimbabwe, the same trend can be observed particularly in mobile wireless systems. These developments have been more pronounced in the last decade. Electronic Payment Systems (EPS) have increasingly become a mode of transacting globally. EPS need to strike a good balance between a number of different issues such as; anonymity (which is the extent to which a third party or the merchant has information about the identity of the buyer) and atomicity (which means the system should be fair and robust in the sense that network failures, for example, do not result in incomplete transactions) (BELLARE, M et al., 1998). All these issues point to a need to design and implement an electronic payment system that would address the specific requirements of the Zimbabwean market as the system has to be unique to the networking conditions and the financial regulations within the country. This paper starts with the introduction and goes to the related work in chapter two, chapter three contains the methodology, chapter four consists of the analysis of the collected data and the design of the model, and in chapter five we have the model evaluation and finally chapter six which is the conclusion and future study.

Keywords:
SMEs- Small and Medium Enterprises
EPS- Electronic Payment System
ICT- Information Communication Technology
B2C- Business to Consumer ecommerce
B2B- Business to Business e-commerce
Merchant- Business or an Enterprise
SSL- Secure Socket layer protocol
TLS- Transport Layer Security protocol
UEPS- Universal Electronic Payment System
1.1 Background

Consumers across the world are increasingly using online business. That is large transactions are being carried out through wireless and wired data transmission networks, with the help of mobile devices and mobile databases so that the distance to a shop is just a click of a button. Generally this is regarded as a little bit advantageous regardless of some inconveniences which can happen especially on the delivery side. In Zimbabwe this kind of handling business is still behind, it is an unfulfilled dream. Worldwide the amount of business done online has grown extraordinarily resulting from the widespread of internet usage and also the decrease of the cost of using it. Bandwidth costs have gone down and internet usage has also improved in Zimbabwe due to the introduction of technologies like CDMA (Code Division Multiple Access) supporting 3G for mobile telecommunications in companies like ECONET wireless Zimbabwe, NetOne, TELECEL Zimbabwe, Africom, Powertel, Broadcom, and Utande. With all this in industry, B2C model should become an easier way of making payments nationwide. The business which is familiar to many internet users worldwide is that of selling virtual products which are mainly games, music, videos or software.

Integrating payment systems developed in different parts of the world with local SMEs is a challenge due to lack of ICT knowledge and limited bargaining power with intermediaries, (BOHLE, Knud, April 2002). In Zimbabwe there is eTranzact (which is the first online real-time payment system in Zimbabwe that allows individuals and corporate account holders to pay for goods and services purchased from merchants), Electra Card Services (which has same attributes as eTranzact). Clients for these two have to be customers of specific banks namely Kingdom Bank and First Bank Corporation respectively.

A lot of instruments have been developed and most of them are under use in Zimbabwe such as eco-cash, electronic cheques, debit cards and credit cards. Most of these have their own advantages and disadvantages with credit cards working a little bit better than others. Online credit card and debit card payment system has been widely accepted by consumers and merchants throughout the world and are by far the most popular methods of payments especially in the retail markets (SINGH, Sumanjeet, 2009). This type of a payment system has
many advantages over the traditional modes of payment. Some of the most important are privacy, integrity, compatibility, good transaction efficiency, acceptability, convenience, mobility, and low financial risk (SINGH, Sumanjeet, 2009). So for this research credit cards and debit cards were used as the payment instruments due to the above reasons.

1.2 Research Focus

This paper addresses the implementation of a universal and standard payment system model in Zimbabwe creating functions for easier integration with local SMEs, also using mobile databases. Moreover, the research focuses on implementing this e-payment model which can be accessed anywhere that is; the geographical location constraint is removed. First, an investigation of the current payment methods used by the local merchants, consumers and banking sector is going to be done to come up with a framework which will implement the important concepts from the investigation. Secondly, we are going to propose a model of a standard payment system, designing functions of integrating with local SMEs and implement the model also using mobile databases for storage. The use of mobile databases is to cater for offline transactions and easier accessibility without location limitations.

1.3 Aims and Objectives

The paper aims to offer integration solutions to the B2C e-commerce with the payment model without tempering around with their security systems. The paper analyses the current payment methods used by the local merchants, consumers and banking sector. It also investigates the current standards and procedures implemented by electronic payment providers and finally it comes up with a model for a universal and standard payment system which is suitable in Zimbabwe. The model has aim to work with any financial institution and merchants especially SMEs. The study will bring awareness to the local business community which is neither Kingdom bank nor FBC bank customers to fully utilize internet for advancement in e-commerce. It will also expand the scope of e-commerce utilization in Zimbabwe at large. Our research may result in an expansion of the customer base for banks if our recommendations are implemented.
2.1 Introduction

Payment system is sometimes used as a synonym for Interbank/Intra-bank Funds Transfer System (IFTS). However at a general level the term “payment system” refers to the complete set of instruments, intermediaries, rules which bind the transactions, procedures, processes and interbank funds transfer systems which facilitate the circulation of money in a country or currency in an area (KOKKOLA, Tom, 2010, p.25). In this case a payment system comprises three main elements or processes:

Instruments: which are a means of authorizing and submitting a payment (i.e. the means by which the payer gives its bank authorization for funds to be transferred or the means by which the payee gives its bank instructions for funds to be collected from the payer e.g. credit card).

Processing: Which involves the payment instruction being exchanged between the banks (and accounts) concerned. The whole action which deduce the success or failure of a transaction (in this case the money transfer).

Settlement: The payer’s bank has to compensate the payee’s bank, either bilaterally or through accounts that the two banks hold with a third-party settlement agent (Kokkola, The Payment System, 2010). The process of discharging obligation from the payer to the payee, this will result to a point where the payer’s account is debited and the payee’s account is credited.

A typical E-payment system structure as shown by Figure 1 below.
2.1 Classification of e-Payment Systems

E-payment systems can be classified into four categories:

- Online credit card payment system
- Online electronic cash system
- Electronic cheque
- Smart cards based electronic payment system (Bohle, April 2002)

These payment systems have numbers of requirements: e.g. security, cost, anonymity, and traceability.
2.1.1 Online credit card payment systems

This payment system has been widely accepted by consumers and merchants throughout the world because of its simplicity, and by far the most popular methods of payments especially in the retail markets (Laudon, 2002). This mode of payment system has several merits, which were never available through the traditional forms of payment. The vital ones are: privacy, integrity, compatibility, good transaction efficiency, convenience, mobility, low financial risk and anonymity. The reason of its simplicity being that consumers only supply the credit card number online which will be associated by public and private safety keys for a transaction to be initiated, this does not add another expense to the consumer of buying other hardware to support encryption as the case in e-cash and e-cheques (Singh, 2009). Overall this has been time-tested and found effective. It also reduce customer’s fears of continual revealing sensitive information on multiple sites. The credit card is associated with a registered company either a credit card issuer company or a bank. Mostly this kind of a payment system incorporate an online authentication process were the credit card number is communicated through secured channels like VPN to the issuers for authentication, validation and balance enquiry if the issuer is a bank. The rest of the proceedings happen at the back end and this is invisible to the consumer and the consumer has no need to be aware of stages being carried at the back end office. That’s were integration of the merchant and the e-payment system comes into play (Singh, 2009).

2.1.2 Online electronic cash system

Electronic cash (e-cash) is a contemporary online payment system which involves digitalized advantages with addition of security and privacy that makes it attractive as compared to paper cash (Singh, 2009). Also its portability and robustness opens up a host of new markets and applications. E-cash is an electronic or digital form of value storage that has limited convertibility and requires intermediaries to convert. E-cash incorporates some properties like monetary value, storability and irretrievability, interoperability and security (Singh, 2009). All these properties woo consumers and display its attractiveness and usage on online e-commerce platforms. It has also its advantages like authority, privacy, good acceptability, low transactions cost, convenience and good anonymity. But has serious short falls especially
forgery which makes consumers shun it these days after discovering it, it is also associated with poor mobility, poor transaction efficiency and high financial risk as people are solely responsible for the lost or stolen (Singh, 2009). Its usage in Zimbabwe is also very low.

2.1.3 Electronic cheque

Electronic cheques offer the need of many businesses electronically and nowadays have reduced the much usage of the exchange of traditional paper cheques with the other vendors, consumers and government. The e-cheque system was designed to work in the same way as conventional paper cheque do (Singh, 2009). The cheque comprises of an electronic document that contains the name of the financial institution; the payer’s account number the name of payee and amount on the cheque. Its difference with the traditional cheque is that much of the information is in encoded form. Now to compensate the signature in paper cheques which is one of the security features on the paper cheques, the e-cheque comprises the digital signature which is a computed number that authenticates the cheque from the owner of the account (Singh, 2009). Its main aim is to extend the functionality of existing cheque accounts for use as online shopping payment tools. This is very important in the sense that by implementing this payment technology we do not totally phase out the functional cheque system. It is advantageous to online consumers in such a way that there is no need to reveal account information to other individuals when setting an auction, continuous sending sensitive financial information over the web is eliminated, it is more cost-effective as compared to credit cards and to support its existence it is much faster than paper based traditional cheque.

However, it has several disadvantages. That is, it has relatively high fixed costs, its use is limited only in virtual world because of the use of external hardware by consumers for digital signatures and certificates, this should be available to improve its security and reduce forgery. Therefore, it is not very suitable for the retail transactions by consumers although useful for the government and B2B operations (Singh, 2009).
2.1.4 Smart cards based electronic payment system

These are basically credit card sized plastic cards with some semiconductor chips which work as memory. Some may have embedded microprocessors which will be implemented to add storage capacity and transaction processing capability (Singh, 2009). Some smart cards have provision to allow users to enter a personal identification number (PIN) code (Emergence of Payment systems in the age of the e-commerce, 2009). There is still a challenge on their use on web based systems because of the need of hardware to read from the microprocessors and write in there again.

2.2 Payment Instruments

Payments system includes not just the automated system but also such soft infrastructure as the payment instruments which are also the basis of transactions (United Nations Economic Commission for Africa, 2010). Many instruments have been developed and most of them have been discussed above and are being used such as e-cash, electronic cheques, electronic purses, debit cards and credit cards. Most of these instruments have their own advantages and disadvantages from the survey done credit cards dominate because of their usability (Singh, 2009).

2.3 Participants in e-Payment System

Payment systems reduce costs, delays of exchanging goods and services and the disadvantages of holding cash therefore they support the growth of online transactions (Anik, 2004) since people have a wide range of choices without much negative factors affecting their choices. Buyers can do their purchases freely after they have done a little research of the product and compare prices on the web search engines. In Africa as elsewhere in the world the development and advancement of payments systems is closely associated with the movement of goods, services, capital and people (Anik, 2004). That is more business means that modern ways of payments will be much relevant, since the market also include merchants and buyers
from abroad. Now the acceptance, safety and efficiency of payments systems are dependent to market participants and public officials in view of their important roles in trade and resource flows and in financial sector development (Anik, 2004). On this perspective as the growth of the payment system users increase new ways of securing the system will emerge and also the acceptance of the system will be certain from marketing aspects.

Merchants play a major role in the development of payment systems. They create opportunities for financial institutions and other payment service providers (Richard Highfield, 2002). Some payment systems failed because merchants were not involved in the development and deployment of these systems (Richard Highfield, 2002). Merchant’s active participation in promoting a payment solution is crucial since this will result in high level of acceptance of the payment system. So the merchant’s contribution do not need to be looked down upon since these are the ones who can decide to altogether reject a payment scheme that would not suit them (e.g. high commission fees) or accept a payment system. Mostly buyers just use the mode of payments which their merchants will be using. A consortium of merchants could have a significant bargaining power against mobile payment service providers (Mallat, 2006).

Also the involvement of financial institutions into the payment system will attract more bank customers and this will result in the increase of banks revenue and finally every business will try to associate itself to the payment system. Every central bank therefore pays close attention to the payment system’s efficiency and functioning to avoid risks(United Nations Economic Commission for Africa, 2010). Banks offer mainly payment methods and payment instruments that enable account holders to transfer money between different accounts (Kokkola, Payments Securities , Derivatives and the role of the Euro system: The Payment system, 2010). They offer the infrastructure of transferring funds to both the payer and payee. Because banks do this in a standardized fashion, network issues came in. Payees can receive funds from anyone with a bank account and payers can pay to anyone with a bank account. Most recently, banks offer their customers Internet banking facilities for managing their current account functionality. Results are increased processing speed and ease of use for both consumers and merchants, and reduction of processing costs for the banks themselves. The number of people using these facilities has grown tremendously in recent years, and the general consensus is that online
banking will become the dominant banking channel even in the future (Kokkola, Payments Securities, Derivatives and the role of the Euro system: The Payment system, 2010).

Payment Service Providers (PSPs) are companies which offer services for online and offline transactions for merchants. PSPs aggregate various payment methods from various acquirers into one contract and one technical interface for merchants (Kokkola, Payments Securities, Derivatives and the role of the Euro system: The Payment system, 2010).

2.4 Present e-Payments

At present e-payments are competitive for purchases of mobile content and items like vending and ticketing, but the traditional payment services still dominate the volume sales. This ensures future research should study the development trends of different payment services and identify opportunities for e-payments (Mallat, 2006). Another area of research is to find whether the value of payment services would be increased by integrating the current chip-based card systems into mobile devices. More research is thus needed to come up with new payment strategies in the future and to come up with new ways of integrating traditional and new payment services if it is necessary to form a seamless overall financial infrastructure for customers (Mallat, 2006).

Significant changes on payment structures have increased especially in 2009 and are set to change the online payments market (Kokkola, Payments Securities, Derivatives and the role of the Euro system: The Payment system, 2010). This change brings in consumer trust as well as service model. Improving security structure may brought up trust which was not in consumers also reducing costs and coming up with new systems which reduce consumer expenditures may induce interest in consumers thereby increase the system’s reputation as well as increase its rate of evolution. We see service providers such as PayPal, Amazon and Google acquiring a role in online payments and traditional banking services. Unless banks pick-up on this trend their role could be marginalized Companies like PayPal, Amazon and Google are used by hundreds of millions of online consumers and are already trusted with payments, shopping, search and email can now also be trusted with additional financial services (Kokkola, Payments
PayPal has steadily been expanding its payments and financial services offerings, especially now as it is now part of one of the biggest e-commerce company E-bay. Also in the past years web merchant Amazon and search engine Google have begun offering extended checkout and payment services and branched out into new domains (Remco Boer, 2010).

PayPal started as an e-wallet but soon by enabling consumers to link their credit cards and bank accounts to their PayPal accounts took on the role of a payment services provider (Remco Boer, 2010). Through integration with PayPal merchants can accept credit cards and other (local) payment methods without having to go through a complex sign up and acceptance procedure with an acquirer. Now on this scenario the merchant open an account with PayPal and it is given a merchant id so all the transfers to the merchant will be received in the PayPal account so that the merchant will always do further transfers to the bank account depending on their business strategies. PayPal has published a series of APIs (Application Programming Interfaces) that describe how other applications can interact with PayPal. Now this is one of the important roles PayPal has played in improving e-commerce by integrating with merchant’s e-commerce platforms. In this way PayPal is starting to act like a payments processor or payments infrastructure provider allowing others to develop user friendly services while earning on the transactions (Remco Boer, 2010). PayPal has open a door to further research on integration and even offering better ways of making payments online.

Another emerging payment gateway being provided by Amazon it started as an online bookseller but quickly grew to become one of the biggest online retailers (Remco Boer, 2010). Amazon had diversified its offerings to include publishing and printing and through Amazon Web Services offers cloud IT infrastructure services, fulfillment and payments (Remco Boer, 2010). Amazon began its payments division in 2007 but has recently made strides in its development becoming something of a payment services provider. With Amazon Checkout merchants have access to payment services while consumers can use their Amazon accounts. Consumers will as well deposit money in their Amazon account which they will use to purchase at Amazon. Amazon also stores the payment and shipping details for easier navigation of the products bought at Amazon (Remco Boer, 2010).
The search giant Google also comes into play by offering many services in addition to search and the related advertising including e-mail; online software for making document, online book archive, translation, social networking (Google+), satellite mapping and many services. At the start of 2006 Google unveiled Google Checkout, effectively introducing a new category of payment providers: ‘search-to-purchase’. Search-to-purchase was a powerful tool on e-commerce which helps consumers extensively to compare prices and even be notified of vendors which they were not aware of. With Google’s search-to-purchase consumers can search for products which Google retrieves from multiple web shops and lists on its webpage. Consumers can sort the products according to price and in the case of books can leaf through a large part of the book online. Consumers are then forwarded straight to the web merchant’s product page where they can select to pay with Google Checkout. Google Checkout enables consumers to link credit and debit cards to their Google account allowing them to pay safely and having to register at Google only. At Google consumers can even track their purchases which make it powerful on world standards of conducting e-payments (Remco Boer, 2010).

(United Nations Economic Commission for Africa, 2010) Concludes that most African national payment systems are weak in technical infrastructure which infers that they are weak in terms of anonymity and atomicity. Bringing the idea that there is a need to implement secure domestic system/network and addressing operations (United Nations Economic Commission for Africa, 2010).
2.5 Existing E-Payment Models

Most E-payment models are derived from the generic model which has basic features of an e-payment model, with additional features which would be found relevant.

There are a lot of existing e-payment models, now looking at the one working model of e-payments which uses credit cards for transactions between customers, merchants and banks. To test and evaluate the payment system an online travel agency called E-Travel which simulates a real-life E-Payment application was developed. The procedure of buying goods in the payment system is the same as that in a real life. The main focus is on the purchasing part (how customers interact with merchants) and the payment process (how money is settled down).
Four major entities involved in the system are consumers, merchants, a payment gateway and banks. A light-weight payment system for E-Payment applications was developed (ISABYASACHI PATTNAIK, 2005 - 2010).

Figure 3: Balasore The model (ISABYASACHI PATTNAIK, 2005 - 2010)

There is another model called person-to-person (P2P) payment system. The model offers a portable e-wallet that is installed in a removable storage (e.g. flash memory). Also the model is supposed to provide a secure and portable payment system which can be conducted by users in P2P transaction. This model can also be used to make micropayments by B2C and C2B. This model works just like e-cash or smart card and it falls under offline payment systems because it uses portable e-wallet with e-cash. The proposed model focuses on: The usage of removable Storage flash memory as client based e-wallet to hold the e-cash. Managing the transaction of P2P payment(HATTAB, A MODEL FOR PERSON-TO-PERSON ELECTRONIC, 2004).
2.6 Limitations of Present e-Payments Systems and Working Models

Generally there is hardly any payment system that is truly integrated in online shopping (studies, 2002). They are payment instruments in Zimbabwe such as e-wallet launched by NETONE and eco-cash launched by Econet but these are not yet used in the online shopping process and they do not have the capacity to produce the data that merchants would like to feed into their legacy back-office systems. Solving these problems would help to increase the efficiency of electronic payment systems (studies, 2002).

Limited adoption of ICT in SMEs is the lack of dynamism between ICT firms and SMEs. When ICT firms provide goods and services in the past for the market it was not necessarily tailored to SMEs because of low demand from SMEs. However their demands are still low since ICT products which are available in the market are complex and expensive. ICT firms used to target large enterprises because they had a larger budget and were willing to pay for more complex ICT services. However competition in this market is making firms both large and small turn their attention towards the untapped SME market (Kotelnikov, 2007).

Although large organizations have invested significant amounts of money to integrate their supply chains, the development of supply chain integration among Small to Medium Sized Enterprises (SMEs) is slow-moving. For SMEs integration with e-payment systems is still a significant problem due to high costs and technology requirements (Hsin Chen, 2004).

Meanwhile transactions in the informal economy the highest denominated notes are still the main payments method for SMEs (Indjikian, 2003). At the same time the propensity to participate in e-commerce and the requirements to enter into the chain of online payments with both corporate and household clients are continuously pushing SMEs to adopt the culture of online payments. The majority of SMEs are still lagging behind the large companies in using Internet as a core element of business and a channel to expand their businesses using e-commerce. Various surveys related to SMEs e-preparedness in developing countries suggest that only less than one quarter of SMEs having the web presence do actually use it as a business instrument i.e. undertaking active Web trading and related e-payments operations.
The majority of SMEs still limit their activities by maintaining a web page with various levels of links and advertising. On Internet they also gather information on markets and competitors as well as searching for partners with further negotiations taking place either through emails or offline while the successful deals are generally completed in a traditional manner, i.e. with traditional paperwork or through the use of cash (Indjikian, 2003). The situation on worldwide SMEs is still the situation of large enterprises in Zimbabwe again deducing that an e-payment system which will integrate with these e-commerce sites will provide a big contribution to the missing link. Many payments are still being carried out in a traditional manner in Zimbabwe despite of merchants advertising online. Some positive signs are noticed on e-payments for SMEs in developing countries which include:

- High level acceptance of technology by customers and financial institutions
- Many innovative approaches
- Initial tangible results in terms of market access and revenues generation.

This will make this research attractive and feasible.

2.7 E-Payment Systems in Zimbabwe

There is eTranzact which incorporates mobile banking, shopping, top-ups payment and funds transfer using mobile, internet and email systems to facilitate funds transfer. In Zimbabwe the system is available via Kingdom bank allowing user’s 24 hour banking services (limited, 2006). ETranzact is the enable of Kingdom bank, which was officially launched on the 24th February 2005; (africa, 2008) the platform is taking care of Kingdom’s clients by providing absolute convenience and ease in banking. The system is mainly used to purchases airtime via the Econet wireless provider (Boyd, 2001).

There is also Electra Card Services (ECS) which is being offered by FBC Zimbabwe. ECS handles complete processing of the debit and credit cards right from applications, billing, statements and payment.
2.8 Mobile Databases

With the advent of mobile databases now users can load up their smart phones or PDAs with mobile databases to exchange mission critical data remotely without worrying about time or distance.

2.8.1 Need for mobile databases

- Mobile users must be able to work without a wireless connection due to poor or even non-existent connections.
- Applications must provide significant interactivity.
- Applications must be able to access local device/vehicle hardware, such as printers, barcode scanners, or GPS units (for mapping or Automatic Vehicle Location systems).
- Bandwidth must be conserved (a common requirement on wireless networks that charge per megabyte or data transferred).
- Users don't require access to truly live data, only recently modified data.
- Limited life of power supply (battery)
- The changing topology of network

2.9 Proposed E-Payment System Model

Looking at eTranzact and other e-payment systems in Zimbabwe there is a restriction that merchants should be that bank’s customers. Now on other e-payment systems integration with SMEs is still a problem. We proposes to design a model of a universal e-payment system which consist or have the following properties:

- Doesn’t consider whose bank’s customer is the merchant and an easier SMEs integration platform.
- This system will make use of mobile databases such as MySQL.
- As the users value convenience more than anything, the payment interface should be user friendly having intuitive outlook.
- The EPS would handle the challenge to integrate the databases used by each of the users, while keeping the data up-to-date.
- A common standard would be imposed and followed; since without standards the wielding of different payment users into different networks and different systems is impossible.
CHAPTER THREE-METHODOLOGY

3.1 Introduction

To Design a user centered EPS model a lot of things has to be taken into consideration. We have to look at who are the major participants in the EPS and how each of these participants contributes to the design of the model. Vital information has to be taken only from major contributors deeply considering what they really want to be included on the EPS. A model of an EPS which is the focus of this paper, usually involve a payer (customer) and a payee (merchant, in this case SMEs which are going to be taken much into consideration) exchanging money for goods or services, and one or two financial institutions acting as an issuer on behalf of the payer or an acquirer on behalf of the payee these in this paper are referred as major players in an EPS. A typical payment system therefore interconnects the payer and the payee and is usually initiated by an instruction from the payer using an agreed instrument through the issuer and acquirer in computer networks which enables them to exchange money(Brooks, 2011).

A mixed research approach was used with an emphasis of qualitative approach because of its array of interpretative techniques which seek to describe, decode, translate and otherwise come to terms with the meaning, not the frequency of naturally occurring phenomena in the social world (BROOKS, Austin Briggs and Laurence, 2011). The aim was to understand the way banks operate, and how best we can integrate merchants’ ecommerce platforms with the new model of the EPS. To maintain the qualitative research approach we used semi-structured interviews for merchants and banks then questionnaires to buyers. The main reason of doing this was for us to find comprehensive information with deep meaning especially from banks and merchants as also the legal aspect of the infrastructure was to be addressed from the bank’s perspectives. A thematic approach was used to analyze the data recorded from interviews and was transcribed to retain the needed information.
The EPS model was designed from data mining, survey, case study and design science. From the data mining we got features which were adapted from the generic model and other models in literature. To Design a user centered EPS model, a lot of things were taken into consideration. We looked at who were the major participants in the EPS and how each of these participants contributes to the design of the model. Vital information was taken only from major contributors considering what they want to be included on the EPS.

We approached banks that had their own e-payments systems and they explained the extent of the integration between their systems and the merchant’s e-commerce platforms. The start-up process for in-house transfers and external (that is paying a merchant with another bank’s account) transfers was explained so that it would be incorporated in the model. We also took suggestions from the experts concerning the introduction of a universal e-payment system. Experts in the banks’ e-commerce departments gave us their ideas about features and functionalities which a universal e-payment system would incorporate and consists of. We also took note of the Zimbabwean business model, and derive that the business model would need an e-payment system which fits into it without anomalies. We considered semi-structured interviews as the best method to collect this information from banks which would be part of the major design and implementation of the model.

For merchants who were already using an e-payment system, we considered their integration with the proposed e-payment system so that some features would be adopted which were already familiar to the users. Conflicts on the instruments to use between merchants and banks were eliminated at all cost. Authentication was considered on both the merchant’s side and the buyer’s side. Therefore, questions were given to the merchants to clarify on their interest in the involvement of the third party; otherwise real authentication would be carried by the issuer and the acquirer. Merchants also chose how they wanted to be notified. Regarding the importance of merchants, semi-structured interviews were used to collect the important information. Some information was collected using questionnaires asking what kind of payment instruments buyers were familiar with which they will easily use online without any need for training. Buyers also propose the means of communication between them and the system.
The population consisted of all 23 banks in Zimbabwe, all merchants in Harare and 200 people who can do transactions online. Looking at the sample we considered 5 banks in Harare. These banks gave a representative sample of the Zimbabwean banking sector; i.e., Very innovative, indigenous, market share, international, and customer diversity. We also discovered that these banks are also working with mobile network providers to provide users with mobile banking and other ways of payments. 18 merchants were approached to give information; we considered mostly young businesses in Harare small shops, butcheries, shops selling electronic gadgets, clothes. We also got some information from big enterprises like Spar which are found nationwide, Barbour’s (one of the big shops selling clothes) and TV sales these are some of the big enterprises in Zimbabwe. 45 questionnaires for buyers were distributed to the University of Zimbabwe students. This sample was assumed effective on gathering required data especially on buyers because a lot of students have the knowledge of using internet and has much access to it freely.

Essential information was collected for the payment system to be acceptable and usable since these are the parties which will use the system.

- **Banks (Acquirer/Issuer):** when the issuer debits a certain credit/debit card account by a certain amount, the acquirer must be in possession of an unforgettable proof that the owner of this credit card has authorized this credit card. The banks must have a secure connection for bank transfers and secure ways of authentication this is really a prerequisite for the success of the EPS. The banks should have a payment instrument which most of them are using and it is secure and efficient. Authentication should be thorough to reduce forgery, insiders and intruders.

We created an option in any case we discovered that the bottom line is there is no universal e-payment system installed, the banks would give their suggestions on what features the universal EPS should have and its operations for it to be accepted in the Zimbabwean business model. For the banks with their e-payment system we had to understand their functionalities so that if possible some operations would be adopted.

- **Merchants (sellers):** Merchants have an important role in the development of payment services. They create the market for financial institutions and other payment service providers.
Some payment solution failures were explained by the lack of merchant involvement in the development and deployment (Mallat, 2006). Their active participation provides an important vote of acceptance. The seller must finally have a stored proof for an order of payment authorized by a customer with a certain id so that the merchant cannot access customer’s bank details. Again the seller must not have the access of the credit/debit card number of the buyer and must have a way of coming to a point where the payment process is declared complete and the customer is in a stage of collecting the goods or services all being processed online.

- **Buyers (Online customers):** Without the credit/debit card number associated with a registered card issuer no transaction must be done. Buyers must be in a position to do their transactions without fear of incomplete transactions or failure of connections and they should opt how they want to be notified during transactions and for complete transactions. Some information therefore need to be collected using questionnaires asking what kind of payment instruments buyers are familiar with which they can easily use online without the real need of training.
CHAPTER FOUR –DESIGN

4.1 Introduction

From the data collected from semi –structured interviews and questionnaires this is what has been found.

❖ Banks: - Kingdom Bank is the on the fore-front in terms of improving its electronic payment system. There is also FBC and CBZ which are coming up with their own ideas and implementations to make real payments online .The overall concept deduced is that banks has really improved their e-business by introducing e-banking, SMS banking, EFTPOS (Electronic Funds Transfer Point Of Sale) and other technologies by integrating with mobile network providers such as ECONET and TELECEL .Many Banks in Zimbabwe are using debit cards, mobile devices and internet banking as their main instruments in banking. Whilst some banks like Standard Chartered are using master cards and visa cards. Looking on their functionalities these cards work the same.

Looking at systems implemented by kingdom bank which some of the features of these systems we adopted in our model. Kingdom bank makes use of mobile banking, in such a way that when their client want to purchase goods or services from a merchant who has a merchant id registered on the Cell card service, the client dials a code *171# or *177# and supplies his/her pin code using the mobile phone then a secret code is sent back to the client then he uses that secret code to authorize a transaction to be done transferring money into the merchant’s account. The cell card services works perfectly with the TELECEL mobile network the mobile number is associated with the client’s kingdom bank account.

Debit cards are used on POS during purchases if the merchant has already installed it. There is no real integration with merchant’s e-commerce platforms for the moment, which makes this model new in the e-commerce world in Zimbabwe. ETranzact is mainly used for bill payments, airtime top-ups and by few merchants in Zimbabwe.
Merchants: - Many merchants advertise their product online that is, using web-technology but there is no real payments conducted online at the moment few SMEs even advertise their products on websites. Merchants in large businesses such as supermarkets and those selling electronic gadgets use POS and other ways of payments for their transactions.

Buyers: - From data collected from students, credit cards and debit cards are the easiest to use on websites since the credit card number is only used for transaction to take place.

4.2 The UEPS model

The model came up from the data gathered and also from the generic model on figure 2 in chapter two. We go on and design the artifact of the model using PHP, MYSQL server, apache, Ozeking SMS gateway and Server working with a modem from one of the mobile network providers. Testing was done using an e-commerce platform we designed called Global Market Place. Only the merchant id, total amount, secret and public keys were sent as hidden variables to the UEPS. Virtual banks were used for testing, LAN was used as the testing environment, one computer was set up as the server, and 25 computers were set as client machines. Different servers with different RAM sizes were used, that is, 512Mb, 1Gb, 2Gb. Concurrent requests were executed the time taken to receive SMS was 2 sec, the whole process took an average of 44 seconds and the worst case was 57 seconds. The checkout time was 1.08 seconds and 7 executions were done to come up with an average time. We realized that, as the number of requests increased, the checkout time increased also, but it was compensated by the increase of RAM size on early stage.

System Functionality and Specifications
From the artifact we came up with the functionalities of the model which are:

- H1: Customer/client after finishing choosing the product from the merchant’s homepage using a client browser which has a secure connection using SSL protocol for information transferring makes a purchase from a merchant server by clicking on a payment (button).
H2: When the EPS receives the message from the merchant the EPS uses the corresponding keys to decrypt the message (H3). The EPS will deduce the issuer (H4) from the credit card number and it will communicate with the issuer through an existing banking network.

EPS encrypts the message and sends it to the issuer
The issuer decrypts the message and processes it
H5: The issuer sends an SMS and email to the customer asking for a pin code associated with the credit card number as a way of improving security.
H6: The customer reply with the pin code then the issuer will communicate with the EPS and the issuer will continue processing the transaction.
H7: The EPS will compose a message to the merchant for record purposes.
H8: Upon the receipt of the EPS’s message the merchant will compose a message to inform the customer whether the purchase is successful the message will be displayed as an HTML document for the customer.
Issuer debits the client’s account and sends an SMS/email, acknowledging that a transaction has happened and there is a new balance in the account
H9 : Issuer transfer the amount to the acquirer
Acquirer credits the merchant’s account.
After a confirmation message is sent to the customer the payment process is said to be complete.
H10: The merchant can check balance and withdraw funds.
THE CONCEPTUAL MODEL OF THE UEPS

Figure 4: UEPS model

Keywords from the EUPS Model

Payment:
- Amt: total amount of the purchased goods
- C#: credit card number of the customer
- C_type: either MasterCard(MC) and VISA(VS)
- C.PK: the digital signature of the message, it uses the client’s private key
- M.id: the merchant’s ID given by the EPS for unique identification of each merchant
- Hi: Sequential order of process where i is a variable.

In coming up with the model, the following assumptions were made:

- The buyer has already an account with the bank refereed here as the issuer
- The credit card is issued by the bank or issuer
- The merchant has an account already with the acquirer
- The response of the bank to the buyer for the new balance is outside the model
- All the processes on the diagram are the ones which are visible on the model.
Figure 5: The sequence diagram of the UEPS model

4.3 System data structure specifications

4.3.1 User Input data (Legal values)

1. Clicks on links which direct to the pages defined in the link
2. Login form: The buyer enters an email address and a password to login and access personal information stored in the database.

Figure 6: Log in form
3. **Registration form:** The buyer’s registration is optional. When the buyer is registering he/she enters the following details when registering a buyer’s account:

- Name(s) (string)
- Surname (string)
- Username (string)
- Email (string)
- Phone number (string)
- Address (string)
- Public key
- Password
Figure 7: Buyer’s registration form
4. **Merchant registration form:** The merchant enters the details of the business which he/she is up to.

- Company name (String)
- Trade name or Username (String)
- Email address (float)
- Location/physical address (string)
- Password (string)
- Confirm password(String)
- Public key(String)
- Type of business e.g. direct sales or auction sales(String)
- Offer e.g. sales or services
Figure 8: Seller’s registration form
5. **Merchant I.D generation**: When the registration was successful that is all mandatory fields have been filled up a merchant id is given to the merchant, which is an auto increment number generated from the database.

6. **Login form**: The merchant enters a user email address and a password to login and access business information stored in the database.

7. **Merchant’s account registration**: During the process of registration, after being given a merchant id the merchant proceed by giving the following.

   - Merchant I.D for verification (string)
   - Bank (acquirer) (string)
   - Branch (string)
   - Account number (integer)
   - Account type (String)
Figure 9: Seller’s registration form 2
8. **Merchant integration with the EPS:** A back end page is going to be designed at the EPS which receives variables from the merchant which are M.ID and the payment information as hidden variables. The information will be encrypted.

9. **Encryption:**

   > A customer presents his or her credit card information (along with an authenticity signature) securely to the merchant.
   > The merchant relays the credit card charge information and signature to its bank or to the EPS.
   > The bank or processing party relays the information to the customer’s bank for authorization approval.
   > The customer’s bank returns the credit card data, charge authentication and authorization to the merchant.

10. **Log in:**

    > For email address authentication at logon, the system retrieves the email address and his password for comparison with the user input values (strings).
    > At user registration, the system compares user username and trade names with that in the database to ensure a unique trade name in the database (strings).
    > The system obtains current date information from the server. (Date within valid date parameters).

4.3.2 **Output specifications**

The system returns to the user pages, information on currently listed items.

*Output data returned to web pages*

*For Buyers, the system randomly returns*

  > The total price
  > An error message if the credit card number is incorrect.
- A waiting message.
- The successful, error and insufficient balance messages.
- An email and an SMS confirming a transaction or asking a buyer to enter the pin code related with an account.
- The buyers information including the bank account balance

**If the user selects the details link, the system outputs the following:**

1. The EPS payment page
2. Login page

If a user selects the EPS homepage page, the system randomly outputs the homepage.
Figure 10: The starter page
4.4 Module Design and Specifications of the Model

4.4.1 Buyers module

The EPS will enable all users to:

➢ Read general information and user guidelines
➢ Register and maintains a user account
➢ Accept the EPS privacy policy and user agreement
➢ Pay or request balance on the EPS.

Buyer

A buyer is the role played by a person who wants to pay online using the EPS

Responsibilities

A buyer has the following responsibilities

1. Create account, uses the EPS to pay his/her merchant
Use case diagram

**Figure 11: Buyer use case**
**BUYER REGISTERS BUYER ACCOUNT**

The EPS shall enable new users to register by creating a user account

**Business Justification**

- Buyer information is required when decrypting the information at the EPS platform.
- Users should be able to reuse their account information

**Use case paths**

- new account created
- account already exist
- username is not unique
- mandatory information missing (enter all details)

**New Account Created**

- The ESP displays the “HOME” webpage on the browser of the user’s personal computer
- The ESP does not record a user account that has the same username, as that in the database

**Interactions**

The buyer uses the “HOME” webpage to send a “Register buyer” request to the ESP the ESP shall respond by displaying a “Register buyer” webpage with the following message requesting the following mandatory information from the buyer:

- Name(s) (string)
- Surname (string)
- Username (string)
- Email (string)
- Phone number (string)
➢ Address (string)

➢ Public key

➢ Password

User name is not unique

The ESP shall require users to select a unique username

PRECONDITIONS

The ESP displays the “home” webpage on the browser on the user’s pc

The ESP does not record a user account that has the same username and either

Post Condition

The ESP displays a “welcome” page, which is a pathway to go to the buyer’s WebPages

Buyer maintains account

The ESP shall enable buyers to modify their accounts

Buyer information updating
Figure 12: Updating buyer’s information
Requirements

The ESP shall enable users to change their names, address, and phone number etc.

PRECONDITIONS

The ESP records a user account for the user
The ESP displays the “home” webpage on the user’s personal computer

INTERACTIONS

- The user uses the ESP HOMEPAGE webpage to send a “update user account” request to the ESP
- The ESP shall respond by displaying a “update user account”

4.4.2 Encryption Module

This module is hidden to all the users but is embedded into the system saving as security of the whole system. First of all we are going to take advantage of the already implemented encryption protocols TLS/SSL protocols in their simplest form. With this protocol the browser encrypts all the data that it sends to the server and decrypts all the data that it receives from the server, also the server encrypts all the data it sends to the browser and decrypts all the data it sends to the browser. The protocol is able to verify if the data has been tampered with during transit it is also able to verify that the server and the client are the ones which it should be communicating with. The URL connection starts with https not http. The server uses SSL server authentication to authenticate itself it does this by providing a digital secure certificate to the browser. And by default browsers accept digital secure certificates that come from trusted sources.

Now for this protocol to provide a more secure connection there must be a digital certificate installed, but this can be used only when it is bought. SSL strength refers to the level of encryption that the secure connection uses during transmission. For better strength bits of 128 to 240 are now used but with different prices. The secure certificate is installed at the server and since most modern browsers support it clients can access the system without problems. And the tip in the security is that the longer the key the more difficult to break the key it is said 128 bit is trillion times stronger than 40 bits. For this cause we are using TSL/SSL and then implement another algorithm below to encrypt the credit card number.
**Another incorporated encryption algorithm:** Each consumer and each vendor generates a public key and a secret key. The public key is sent to the EPS and put on its public key server. The secret key is re-encrypted with a password, and the unencrypted version is erased. To steal a credit card a thief would have to get access to both a consumer’s encrypted secret key and password. The credit card company sends the consumer a credit card number and a credit limit. To buy something from vendor X, the consumer sends vendor X the message, ‘It is now time T. I am paying Y dollars to X for item Z,’” then the consumer uses his or her password to sign the message with the public key. The vendor will then sign the message with its own secret key and send it to the credit card company through the EPS, which will bill the consumer for Y dollars and give the same amount.

**4.4.3 EPS Module**

This module receives hidden information from the merchant, decrypts it, process it, encrypts it again and sends it to the issuer. The issuer receives the encrypted information, decrypts it, and process it. The EPS communicates with the merchant to and fro. So a platform was developed which receives the hidden fields together with the buyer’s information.

**4.4.4 Credit card authenticator Module**

![Figure 13: A typical credit card](image)

This module deduces the bank and the account number of the buyer, and the result is send to the issuer for verification. There is an algorithm to deduce the corresponding issuer from the debit card/credit card number.
4.4.5 Seller/Merchant module

Responsibility of a seller

- Follows merchant agreement.
- Registers payments with EPS.
- Integrates the e-commerce platform with EPS.

After a merchant is given a merchant id, the merchant will use the merchant id, the total price of goods in the shopping cart to post all these as hidden variables to the EPS. There is an interface at the EPS which is standard which can integrate with any shopping cart after downloading the API for integration.
Typical user interface of a shopping cart

Figure 14: shopping cart
Create a platform with standard mark up language for easier integration with the EPS.

Web Pages

- Merchant reads seller guidelines
- Merchant obtains a merchant identity number.
- Integration page
- Authentication page

Merchant read guidelines

Externals: – Merchant.

Preconditions

The EPS displays a web page enabling the seller to read the seller guidelines.

Interactions

1. The seller sends a read seller guidelines request
2. The ESP shall respond by displaying the seller guidelines page to the seller.

Merchant registers.

The EPS shall enable sellers to register to make payments.

Justification

- Only the seller is the source of the success of the EPS.
- Seller demands simple integration with the EPS
- To come to the final point of a transaction it’s through the EPS.

Functionality of the Merchant platform

When a buyer clicks buy the credit card information and the merchant’s details are posted to the EPS. Also when an EPS receives information from the acquirer must have away to send it to the merchant so that finally the information is displayed as an html document to the buyer conveying either a successful or a failure message.

Payment

Path Requirement
After pressing the buy button at the merchant’s e-commerce platform the buyer is directed to the EPS.

**Externals**

Buyer (Client)

**Preconditions**

- The EPS displays a webpage on the browser of the buyer’s personal computer that enables the buyer to enter the credit card number:
Figure 15: The buyer enter the credit card number

Interactions

- The buyer enters the credit card number.
- The buyer receives an SMS and email asking for the pin code
- The buyer receives an successful or failure messages at the EPS browser
Post conditions

- If successful the buyer is directed to the merchant’s platform were he/she is granted access to the goods or services at the merchant’s site.
- The buyer collects the goods or services

4.4.6 Settlement module

For a payment instruction in a payment system, settlement occurs when funds are transferred from the payer’s bank to the payee’s bank. Finality may occur the moment payment instructions are entered into the system and technically validated, the Moment the payment instruction is processed and the resulting balance is settled or at any point between those two extremes. The clearing and settlement of card transactions is based on a store-and-forward basis, The stored transaction data at the card-reader units are either transmitted by network after working hours, or retrieved by a hand-held device such as a Pocket PC. On EPS settlement comes into play when funds are transferred to the acquirer and the buyer receives a confirmation about the new balance as well as the merchant. Acknowledgements are conveyed as SMSs and emails.

4.4.7 SMS module

For the model to send an SMS, we use an OZEKEI NG SMS gateway, the OZEKI SMS server and a TELECEL modem with the TELECEL SIM card. The gateway integrate with the modem and the model such that a PHP code in the model is used for that integration. Now when a buyer is making a payment during the time when the buyer enter the credit card number he/she will also receive an SMS to authenticate the buyer. After the delivery of the pin code to the system the transaction will proceed. The mobile number will be taken from the database, during the process of authenticating the credit card number a table called ozekimessageout is inserted data that comprises the whole information fit for an SMS to be sent. Also when the buyer respond with an SMS containing the pin code a table in the database named ozekimessagein is inserted so that the system will make use of that information matching with that which is already in the bank’s database. The following are the screenshots showing the SMSs received and sent by the gateway working with the EPS model.
Figure 16: The inbox
Figure 17: The sent box
The Ozekimessageout database table

![Database Design](image)

**Figure 18:** The ozekimessageout

### 4.5 Database Design

Databases:

- Buyer
- Merchant
- EPS
- Banks
Bank_code

**BUYER**

Buyer

<table>
<thead>
<tr>
<th>Email</th>
<th>Name</th>
<th>Sname</th>
<th>username</th>
<th>Phon_num</th>
<th>address</th>
<th>Public key</th>
<th>password</th>
</tr>
</thead>
</table>

Payment

<table>
<thead>
<tr>
<th>Email</th>
<th>Amount</th>
<th>Trans_id</th>
<th>Time</th>
<th>Trade name</th>
<th>Credit card #</th>
</tr>
</thead>
</table>

Product

<table>
<thead>
<tr>
<th>Prod_id</th>
<th>Quantity</th>
<th>Prod_name</th>
<th>Prod_price</th>
</tr>
</thead>
</table>

**MERCHAND**

Reg_1

<table>
<thead>
<tr>
<th>Co.name</th>
<th>Trade name</th>
<th>Email</th>
<th>Address</th>
<th>Password</th>
<th>Business type</th>
</tr>
</thead>
</table>

Reg_2

<table>
<thead>
<tr>
<th>Merchant_id</th>
<th>Acquirer name</th>
<th>Acquirer – branch</th>
<th>Acc_num</th>
<th>Public key</th>
</tr>
</thead>
</table>
### EPS → database

**Transaction**

<table>
<thead>
<tr>
<th>B_email</th>
<th>Merchant_id</th>
<th>Merchant_email</th>
<th>Amount</th>
<th>Quantity</th>
<th>id</th>
</tr>
</thead>
</table>

**Authenticator**

<table>
<thead>
<tr>
<th>Merchant_public_key</th>
<th>Buyer_public_key</th>
</tr>
</thead>
</table>

**Pro_intrans**

<table>
<thead>
<tr>
<th>Transaction_id</th>
<th>Prod_id</th>
<th>Prod_name</th>
</tr>
</thead>
</table>

**Bank**

<table>
<thead>
<tr>
<th>Bank_code</th>
<th>Bank_name</th>
</tr>
</thead>
</table>

### BANK.CODE → database

**Private_accs**

<table>
<thead>
<tr>
<th>Acc#</th>
<th>Phon#</th>
<th>Email</th>
<th>Pin_code</th>
<th>Balance</th>
<th>Name</th>
<th>sname</th>
</tr>
</thead>
</table>

**Merchant acc**

<table>
<thead>
<tr>
<th>Acc#</th>
<th>Email</th>
<th>Phon#</th>
<th>Pin_code</th>
<th>Trade_name</th>
<th>Co_name</th>
</tr>
</thead>
</table>

**Debit cards**

<table>
<thead>
<tr>
<th>Debit card#(auto increment)</th>
<th>Acc#</th>
</tr>
</thead>
</table>

**ATM cards**

<table>
<thead>
<tr>
<th>Pin_num</th>
<th>Acc#</th>
</tr>
</thead>
</table>
4.5.1 ERD design

Buyer

![ERD diagram for Buyer database]

Figure 19: Buyer database

Merchants

![ERD diagram for Merchants database]

Figure 20: Merchants database
EPS

![Database diagram for EPS](image)

Bank Code

![Database diagram for Bank Code](image)
5.1 Introduction

The model which I named UEPS (Universal Electronic Payment System) was evaluated based on the following attributes which are anonymity, traceability, security, portability, atomicity, cost effectiveness, standardization and universality (range of applicability) and level of integration. We compared with a model which was developed at Balasore and ETranzact which is an e-payment system which is being used in Zimbabwe which has some similar features with UEPS and we found the following.
Table 1: Comparing the attributes of our model to eTranzact and Balasore models

<table>
<thead>
<tr>
<th>Attributes under test</th>
<th>UEPS</th>
<th>eTranzact</th>
<th>BALASORE (model)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anonymity</td>
<td></td>
<td>limited</td>
<td></td>
</tr>
<tr>
<td>Applicability</td>
<td></td>
<td>limited</td>
<td>Limited</td>
</tr>
<tr>
<td>Level of integration</td>
<td></td>
<td>much limited</td>
<td>✗</td>
</tr>
<tr>
<td>Traceability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Security</td>
<td></td>
<td></td>
<td>insecure</td>
</tr>
<tr>
<td>Portability</td>
<td>limited</td>
<td></td>
<td>limited</td>
</tr>
<tr>
<td>Atomicity</td>
<td>limited</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost effectiveness</td>
<td></td>
<td>limited</td>
<td></td>
</tr>
<tr>
<td>Mobility</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2: Performance comparison of our model to eTranzact and Balasore models

<table>
<thead>
<tr>
<th></th>
<th>UEPS</th>
<th>eTranzact</th>
<th>Balasore</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level of Integration</strong></td>
<td>There is a downloadable API</td>
<td>Enables account holders to pay for goods and services from participating merchants</td>
<td>Integrate with E-travel agency.</td>
</tr>
<tr>
<td></td>
<td>Need merchant id and the total amount to start up a transaction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Anonymity</strong></td>
<td>eliminating continuous use of buyer’s sensitive information</td>
<td>Subscribers need extra card</td>
<td>The credit card number is the only buyer’s information used in a purchase, and it is stored at the buyer’s bank.</td>
</tr>
<tr>
<td></td>
<td>The issuer provides the credit card no third part</td>
<td>No central Information storage.</td>
<td></td>
</tr>
<tr>
<td><strong>Traceability</strong></td>
<td>The issuer and the UEPS have an unforgettable proof of transaction.</td>
<td>A profile is created for the Cardholder</td>
<td>The payment gateway is used to trace transactions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Web Access identifies the Cardholder</td>
<td>The receipt number is also used to trace purchases.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transactions can be traced from start to finish.</td>
<td></td>
</tr>
<tr>
<td><strong>Mobility</strong></td>
<td>Web access only</td>
<td>Mobile phone and internet accessibility</td>
<td>Online web access</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Security       | Uses the TSL/SSL protocol.  
|               | The consumer and each vendor generate a public key and a secret key. The public key is sent to the EPS. The secret key is re-encrypted with a password.  
|               | There is offline authentication of an SMS. | Uses SSL encryption and other banks security systems. | Use the merchant’s private and public key and the Payment gateway’s public and private key to encrypt and decrypt.  
|               | It also uses insecure private network for communication between the merchant and the payment gateway. |
| Portability   | Accessible online using Web | Accessible on WAP and Web. | Accessible online using Web |
| Atomicity     | Based on the availability of UPS and high bandwidth, not yet tested on WAN environment, is lightweight | Installed UPS, high bandwidth network connectivity. | The system is lightweight. |

- The level of integration is high

There is a downloadable API for integration which any merchant including SMEs will download and finally use only the merchant id and the total amount in the cart to start up a transaction.
The proposed model supports Anonymity
Proof: This is the extent to which a third party bank or other payment service provider or the merchant has information about the identity of the buyer. In this model the buyer’s account details is only stored by the issuer. This model supports anonymity by eliminating continuous use of buyer’s sensitive information for every transaction (that is, it does not need much details from the buyer for a transaction but buyer’s information would be supplied by the issuer) except the credit card number, this reduce the mistrust of unfamiliar users which do not want to reveal their names frequently. Moreover the merchant cannot view the buyer’s details on the e-payment system. The Buyer’s bank is the one which need to store buyer’s details so that the identification of an account deduced from the corresponding credit card number will be effective and done in real time.

Traceability is possible in this model
Proof: When the issuer debits a certain credit/debit card account by a certain amount, the issuer has an unforgettable proof that the owner of this credit card has authorized this credit card also the EPS itself has a record that a transaction has occurred at which time and it has a record of the parties who participated in the transaction this can be easily traced when it is needed. The credit card can also be used for tracing transactions, we can bear in mind that there must be a good balance between anonymity and traceability to come up with a functional model as well as a secure model.

The model is secure
Proof: The model first of all makes use of the TSL/SSL protocol which can be configured on the web server this helps on encoding all data which is being entered on the web page so that it will not be transmitted as raw as it is on the network as well as to the web server and the databases. The SSL protocol makes use of the RSA algorithm for encryption. The model also implements the public key encryption algorithm stated in the encryption module in chapter 4 to further improve the security feature of the model. The model also use the safety key which is only known by the buyer and an offline authentication were by the buyer receive an SMS requesting a pin code so that the payment transaction will be processed. The model doesn’t come up with its new channels of transmitting data to banks but use the already installed secure infrastructure to transmit data. Moreover the banks also use their channels which they are currently using for data transfer to and from branches and to other banks. There is also secure
integration of the merchant’s e-commerce platform with the model by making use of hidden variables and sessions.

- The model is portable
  The model is portable since it can be accessed by any device which can install a browser for accessing websites and MYSQL database is also portable.

- The model is usable
  Proof: Taking in consideration that many banks in Zimbabwe are offering e-banking the model is usable because of its interface which is similar to that on the e-banking platforms also the interface is self-explanatory and descriptive so that users will not be confused whilst using it. The language is also familiar to those who were using offline systems, meaning that they will not face something new totally.

- The model supports atomicity
  Proof: Atomicity (which means the system should be fair and robust in the sense that network failures, for example, do not result in incomplete transactions). The model should use UPS which allows resume of a transaction if there is a power cut during a transaction. The model does not incorporate flash applications on the interface which results in short response time thereby supporting atomicity. Also APACHE server is portable and less heavy for average speed networks such as the ones in Zimbabwe.

- The model is cost effective
  Proof: The model does not need an extra hardware for transactions on the client side as most of the functionality of the system will be done on the server, thereby limiting customer’s expenses. The checkout time is 1.02 seconds which when compared to other models in the table work better. Overall evaluation is that the model is fast from the testing above and cost effective since buyers can do all their purchasing whilst seated reducing risks like theft and robbery.
CHAPTER SIX-CONCLUSION

6.1 Conclusion

Effective and Efficient universal e-Payment system is a need in Zimbabwe to solve some problems which are currently encountered in e-commerce. After discovering that there is less integration of existing e-payment systems with merchant’s sites and systems, moreover PayPal as one of the most popular e-payment systems opening a door for research in integration we prompt into this study. We discovered that a payment model that will create the road to a payment system containing the attributes such as anonymity, security, simple integration and some which are expected on an e-payment system will give a solution to the current problem.

We designed a light weight e-payment system model, universal and offering better integration to all merchants as well as SMEs. It has its own security features especially the offline authentication method and security aspects. As a way of testing the model we designed a small e-commerce system which we named global marketplace to test the model’s functionality and integration with shopping carts. As we compared its operations with existing systems we found that it offers better services which most of the people need to accomplish their businesses online in real time.

6.2 Recommendations

For further work new security systems on the e-payment model need to be addressed to cope up with everyday technology and also to incorporate other payment instruments on the e-payment model, since we have been focusing on credit cards alone. As integration on e-payment systems is evolutionary a further review on the level of integration might need to be done as further research as well, since most of it depends with the security features implemented and the level of programming language that is under use, such as 4G or 2G.
REFERENCES


DCB. (n.d.). Retrieved from Data comm for Business: www.dcbnet.com


Emergence of Payment Systems in the age of the e-commerce. (2009).

Finland, H. L. (2010, March). Simulation as a tool for Payment System oversight and Policy.


The standardized shopping cart code

```php
session_start();
$PHPSESSID = session_id();

// connect to database
$conn = mysql_connect("localhost","root","root")
or die(mysql_error());

mysql_select_db("gmp1",$conn) or die(mysql_error());
$m_id=4;

$display_block = "<h1>Your Shopping Cart</h1>";
//$total_amt = 0;

// check for cart items based on user session id
$get_cart = "select st.id, si.item_title, si.item_price, st.sel_item_qty,
st.sel_item_size, st.sel_item_color from shoppertrack as st
left join store_items as si on si.id = st.sel_item_id where
session_id = "$PHPSESSID"";

$get_cart_res = mysql_query($get_cart) or die(mysql_error());

if (mysql_num_rows($get_cart_res) < 1) {
    // print message
    $display_block .= "<P>You have no items in your cart.
    Please <a href="interface.php">continue to shop</a>!";
```
} else {

// get info and build cart display

DISPLAY_BLOCK .= "

<table cellspacing=2 border=0 width=98%>
<tr>
<th>Title</th>
<th>Price</th>
<th>Qty</th>
<th>Subtotal</th>
<th>Action</th>
</tr>

while ($cart = mysql_fetch_array($get_cart_res)) {

$id = $cart['id'];

$item_title = stripslashes($cart['item_title']);

$item_price = $cart['item_price'];

$item_qty = $cart['sel_item_qty'];

$item_color = $cart['sel_item_color'];

$item_size = $cart['sel_item_size'];

$total_price = sprintf("%.02f", $item_price * $item_qty);
$total_amt += $total_price;

</tr>

";

}
```html
$display_block .= "<tr>
<td align=center>$item_title<br></td>
<td align=center>$item_price<br></td>
<td align=center>$item_qty<br></td>
<td align=center>$total_price</td>
<td align=center><a href="removefromcart.php?id=$id">remove</a></td>
</tr>";
}

$display_block .= "</table>";
}
?>

<HTML>
<HEAD>
<TITLE>My Store</TITLE>
</HEAD>

<BODY>
<center>
<?php echo $display_block; ?></center>
<table align="center" border="0" cellpadding="1" cellspacing="1"><tr><td bgcolor="" TOTAL:"/td><td bgcolor="">$<?php echo $total_amt;?></td></tr></table>
<form action="https://10.50.20.174/greenlake/seller.php" method="post">
<input type="hidden" name="sub_total" value="<?php echo $total_amt; ?>">
<?php $tr_amnt=$total_amt; ?>
</form>
```
<input type="hidden" name="ses_id" value="<?php echo PHPSESSID; ?>"><input type="hidden" name="tamnt" value="<?php echo $tr_amnt; ?>"><input type="hidden" name="shop_id" value="4"><input type="hidden" name="t_status" value="true">

<table align="center" width="300" border="0" cellspacing="1">
<tr>
<td align="right"><a href="interface.php">
<form action="interface.php" method="post">
<input type="submit" name="more" value="More items!"></form></a></td>
<td align="center">OR</td>
<td align="left">
<input type="submit" name="submit" value="Press Order!"></td>
</tr></table>
</form>
</td></tr></table>

</form>
</BODY>
</HTML>

The API (Application Programming Interface) for EPS

<?php
ob_start();
session_start();
if(isset($_GET['MID'])) {

 include_once './functions.php';

$str_status = isset($_POST['t_status']) ? $_POST['t_status'] : false;
$str_amnt = isset($_POST['tamnt']) ? $_POST['tamnt'] : 0;
echo $str_amnt;

$_SESSION['shopID'] = isset($_POST['shop_id']) ? $_POST['shop_id'] : 0;

$error_msg = array();
/***********************/

include_once('db_merchants.php');
if (!function_exists("GetSQLValueString")) {


function GetSQLValueString($theValue, $theType, $theDefinedValue = "", $theNotDefinedValue = "")
{
    if (PHP_VERSION < 6) {
        $theValue = get_magic_quotes_gpc() ? stripslashes($theValue) : $theValue;
    }

    $theValue = function_exists("mysql_real_escape_string") ?
                mysql_real_escape_string($theValue) :
                mysql_escape_string($theValue);

    switch ($theType) {
    case "text":
        $theValue = ($theValue != "") ? "" . $theValue . "" : "NULL";
        break;
    case "long":
    case "int":
        $theValue = ($theValue != "") ? intval($theValue) : "NULL";
        break;
    case "double":
        $theValue = ($theValue != "") ? doubleval($theValue) : "NULL";
        break;
    case "date":
        $theValue = ($theValue != "") ? "" . $theValue . "" : "NULL";
        break;
    case "defined":
        $theValue = ($theValue != "") ? $theDefinedValue : $theNotDefinedValue;
        break;
    }
    return $theValue;
}

$loginFormAction = $_SERVER['PHP_SELF'];
if (isset($_GET['accesscheck'])) {
    $_SESSION['PrevUrl'] = $_GET['accesscheck'];
}

if (isset($_POST['email'])) {
    // Check, if user is already login, then jump to secured page
    if (isset($_SESSION['email'])) {
        //***********************************header('Location: seller.php');
    }
    $loginUsername=$_POST['email'];
    $_SESSION['loginUsername']=$_POST['email'];
    $password=md5($_POST['pass']);
$MM_fldUserAuthorization = "";
$MM_redirectLoginSuccess = "seller_home.php";
$MM_redirectLoginFailed = "seller.php";
$MM_redirecttoReferrer = true;
mysql_select_db($database_merchants, $merchants);

LoginRS__query=sprintf("SELECT email, pass FROM reg_1 WHERE email=%s AND pass=%s",
GetSQLValueString($loginUsername, "text"), GetSQLValueString($password, "text"));

>LoginRS = mysql_query($LoginRS__query, $merchants) or die(mysql_error());
$sql = "SELECT * FROM reg_1 WHERE email='$loginUsername' AND pass='$password'";
$r = mysql_query($sql);
if (mysql_num_rows($r)==1) {
    $loginStrGroup = "";
    //declare two session variables and assign them
    $_SESSION['email'] = $_POST['email'];
    $_SESSION['MM_Username'] = $loginUsername;
    $_SESSION['MM_UserGroup'] = $loginStrGroup;
    if (isset($_SESSION['PrevUrl']) && true) {
        $MM_redirectLoginSuccess = $_SESSION['PrevUrl'];
    }
    header("Location: " . $MM_redirectLoginSuccess);
} else {
    //header("Location: ". $MM_redirectLoginFailed )
    $msg = '<h2>Wrong combination of email address and password please try again</h2>'; 
}

/******************************************/
if($tr_status == true) $tid = GenTransID(7);
$_SESSION['TID'] = $tid;
if (isset($tid))
{ 
    if(!valid_transaction($tid))
    {
        header('Location: fail.php');
    }
exit;
}

save_trans_info($tid, $tr_amnt, $_SESSION['shopID']);

header('Location: creditCard.php');

} else {
    // display normal page
}

/*******************************************/
?>
APPENDICES

SEMI-STRUCTURED INTERVIEW TO FINANCIAL INSTITUTIONS

1) Does the bank have a functional e-payment system …………………………………………………………………

2) If the answer to 1) is yes
   • Which payment instruments are you using
   …………………………………………………………………………………………………………………………………………………………………
   …………………………………………………………………………………………………………………………………………………………………
   …………………………………………………………………………………………………………………………………………………………………
   • Is there any integration with merchants/businesses online
   …………………………………………………………………………………………………………………………………………………………………
   …………………………………………………………………………………………………………………………………………………………………
   …………………………………………………………………………………………………………………………………………………………………
   • How do you authenticate payments either in house or to other banks
   …………………………………………………………………………………………………………………………………………………………………
   …………………………………………………………………………………………………………………………………………………………………
   …………………………………………………………………………………………………………………………………………………………………
   • How do you offer online integration with merchants and your payment system
   …………………………………………………………………………………………………………………………………………………………………
   …………………………………………………………………………………………………………………………………………………………………
   …………………………………………………………………………………………………………………………………………………………………
   • How does the payment system initiate or stimulate transfers of funds in-house and to other banks
   …………………………………………………………………………………………………………………………………………………………………
   …………………………………………………………………………………………………………………………………………………………………
   …………………………………………………………………………………………………………………………………………………………………
   • If designing a universal e-payment system what do you think it should include or comprise for it to function very well and be acceptable with the majority of customers who buy goods online, the merchants and all local banks
   …………………………………………………………………………………………………………………………………………………………………
   …………………………………………………………………………………………………………………………………………………………………
   …………………………………………………………………………………………………………………………………………………………………

3) If the answer to 1) is no
   • Proposing a universal payment system which can be used by any customer of any bank and with all local banks what do you think it should consists of, as it should be online and can be used by any merchants worldwide What information is required for a transaction to be called done on an online transaction
   …………………………………………………………………………………………………………………………………………………………………
   …………………………………………………………………………………………………………………………………………………………………
   …………………………………………………………………………………………………………………………………………………………………
   • How do you think the suggested universal e-payment system should operate for transactions to be done that is, at the end of the day (the customer’s account is debited and the merchant’s account is credited) and an acknowledgement to be sent to both parties notifying them of a transaction which
has been done on real-time

• What do you suggest on the idea of a third party, that is the one who stores information on behalf of the customer and merchant

• Still on the third party, do the third party need its separate account (intermediate account) so that both client and merchant need to open a virtual account with that third party, then the third party will finish the transaction either online or offline

4) What is your opinion on the design and implementation of the universal e-payment system