e-Payment: Challenges and Opportunities in Ethiopia

by

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1. Background

Nowadays, societies have well recognized information and knowledge as invaluable resources. The ‘agricultural age’, the period when majority of workers were farmers, and the ‘industrial age’, the period when work processes were simplified through mechanization and automation, had to pass before the advent of the present ‘information age’. The information age began in the 1960s when majority of workers are involved in the creation, distribution, and application of information [1]. The developed countries came through the two preceding ages to reach the information age. The contemporary developing countries, however, host elements from the three ages. There is a mixed sort of development. The trend, nevertheless is that eventually the development of information and communication is to surpass the two and prevail in every aspect of society’s social, political and economic life.

The assumption of perfect knowledge among economic agents made neoclassical economics to avoid studying information and communication. The value of information was traditionally seen as derived exclusively from reducing uncertainty. Since particularly the 1960s, however, economics has paid increasing attention to them [2]. In the Internet economy, information is simultaneously a production asset or an input like natural resources, labor, capital, and entrepreneurship. It is unique from other resources in the sense that it can be used, reused, processed, shared, and exchanged without losing value.

The astonishing growth and sophistication of information and communication technology (ICT) is changing societies’ ways of life in various parts of the world. One of the leading areas where this is manifested is the way business is conducted. The growth of the Internet and World Wide Web (WWW) has made electronic commerce (e-commerce) possible. E-Commerce in its simplest sense is trading electronically. It offers consumers and merchants convenience and speed. The success and growth of e-commerce, however, depends on efficient electronic payment (e-payment) system. The slogan ‘it is no e-commerce, if you can’t get paid’ witnesses the importance of e-payment for e-commerce. E-payment, the transfer of value electronically, in turn depends on secure ICT infrastructure, efficient legal and regulatory regime, and widespread awareness among the public and business. In this paper we look at these and other relevant issues from global, African and Ethiopian perspective.
1.1 Objectives and Methodology

1.1.1 Objective of the project

The objective of this project is to study e-payment practices in developed countries, Africa and Ethiopia. In addition an e-payment model that is appropriate to Ethiopia will be proposed. A prototype that demonstrates the proposed model will also be developed.

Specifically in this project we

- conduct general literature review of e-payment from global perspective
- conduct literature review of e-payment from African perspective
  - What exist (some north African countries) ,e-payment method
  - What regulatory mechanism exists
- study the case of Ethiopia
  - Review existing e-payment system in Ethiopia.
  - Investigate challenges to e-payment in Ethiopia (legal/regulatory, infrastructure, socio-culture).
  - Propose and test an e-payment system that can be used in Ethiopia.
- make conclusion and recommendations

1.1.2 Methodology

To conduct this project the following methods were used.

- Literature review.
- Interview with open-ended questions.
- On-site observation.
- Selection and use of appropriate e-payment system development tools.

1.2 Importance and Challenges of E-Commerce

In the developed countries, today, consumers and businesses have recognized the potential and benefits of adopting computer-enabled networks. Consumers now use computer networks to identify sellers, evaluate products and services, compare prices, and exert market leverage. Businesses use them to conduct and re-engineer production processes, streamline procurement processes, reach new customers, and manage internal operations [3].

Recently, merger of computers and communication technologies is producing technological convergence. Mobile phones can send and receive picture and text-
messages. The new generation of television system provides full interactive media and information centers. The computer is now television and vice versa [4, 5].

Now there is increasing attention being given to information and communication technology in many countries. The Ethiopian government believes that information technology has the power to counteract poverty. The government is working with US technology firm Cisco to provide universal net connectivity for the country over the next few years. This has a paramount implication for the growth prospects of e-commerce and e-payment infrastructure, which is one of the basic prerequisites in the expansion of the same [7].

E-commerce has gained growing attention in many countries, particularly since the 1990s from both entrepreneurs and consumers. In 1991, the Internet had less than 3 million users around the world, and its application to e-commerce was non-existent. By 1999, an estimated 250 million users accessed the Internet and approximately one quarter of them made purchases online from e-commerce sites, worth approximately $110 billion [6].

The major benefits of e-commerce include the following among other things.

♦ Improved response time: communication and flow of information become quick and cost efficient.

♦ 24/7 World: Round the clock availability of goods and services. Communicating, making order, buying, selling, and paying occurs 24 hours a day, 7 days a week and 365 days a year.

♦ Extended market reach and revenue potential, and a wide range of choices and convenience for the customer. Geographic barriers or boundaries are removed. A merchant can reach a customer who is physically too far away. The customer on the other hand, can make purchases from a merchant who would otherwise not have been accessible to him.

♦ Improved competitive positioning: The benefits of e-commerce are not limited to large entities. Small and medium enterprises (SMEs) are also equal participants in the virtual environment.

♦ Reduced costs for the business firm and reduced price for the consumer. Consider a normal auction on one hand and an Internet auction on the other hand. In the first case, one has to pay for the person conducting the auction and the place where the auction is being held. In the second case, one just
has to pay for the web application conducting the auction, which in general will be too cheap or might even come for free. This coupled with the fact that there is increased competition in e-commerce would force businesses to avail their products and services at lower prices but with enhanced quality.

However, there are some problems related to e-commerce that have greatly held its progress. The impacts and policy challenges of e-commerce can be viewed from three perspectives. From legal and regulatory point of view, the virtual environment of electronic markets makes it more difficult to determine who the contracting parties are, where e-commerce operator is established, and whether that operator is complying with all relevant legal obligations and regulatory bodies, and hence uncertainty about which jurisdiction will be competent and about the applicable laws in disputed cases will arise. From social and technical point of view, there are problems related to security and privacy, acceptability of electronic signatures and documents, and contract enforcement. From economic policy point of view, e-commerce is likely to bring significant effects on the structure and functioning of the economy. Such are likely to manifest themselves on prices, composition of trade, labor market and taxation revenues. There is a mounting concern among tax authorities on the implications of growth of e-commerce on tax revenues. E-commerce has the potential to undermine domestic and national tax policies. In Value Added Tax (VAT) System, for example, e-commerce offers the difficulty on the side of suppliers to prove the location of consumers to collect consumption tax.

Another policy challenge that deserves a special attention relates to monetary policy [8]. The development of Internet and e-commerce could modify the cyclicality of economies and how payments are made. Friedman as cited in Copell [8] argues that Internet related technologies could increase the speed of financial operations, which raise issues as to how and when to set the interest rate. King also cited in the same publication emphasizes that technological developments may emasculate the monetary control of banks. This could occur if real time pricing and exchange of goods is permitted across the Internet without the intercession of an independent monitory system administered by a central bank [8].
1.3 E-Commerce and Developing Countries

The economic relevance of e-commerce for developing countries can be viewed from two broad perspectives.

First, it is an opportunity in the sense that e-commerce creates comparative advantages to developing countries. These countries are generally characterized by lower man-power costs so anything that reduces costs of communication, warehousing and so on, will put the companies therein in comparative advantage, e-commerce surely, emerges as a good candidate. Moreover, the barriers to entry into e-commerce are relatively low. Developing a website is a low cost exercise compared with setting up retail stores that would cater for the same market size [9]. Still more importantly, by creating new market opportunities beyond the domestic economy, e-commerce enables companies in developing countries to exploit economies of scale.

Secondly, e-commerce is becoming a fact of the rapidly globalizing world. Freer international trade and increasing open-ness continue to play a prime role in integrating the world into a village [10]. Hence, getting connected to the wired world will be a prerequisite to succeed in this world of competition. Otherwise, the threat of the digital divide will inevitably exacerbate the existing economic and technological inequality between the developed net-haves and the developing net-have-nots.

Barnes and Huns [11] write:

*Electronic-Commerce (EC) is demonstrating its potential to turn the business world on its head. Few, if any, companies or industry sectors are protected from electronic commerce incursion, and there is little doubt that e-commerce will separate business winners and losers.*

The realization of e-commerce at national or international level like any other transaction depends on a proper e-payment system. The nature and type of means of transferring value obviously have a bearing on the speed, convenience, and hence success of transactions and overall performance of the economy.
2. Overview of E-payment

2.1 Introduction

Payment is generally understood as a transfer of funds from the payer to the payee. Electronic payment is a payment carried out electronically. The European Central Bank defines e-payment as "a payment that is initiated, processed and received electronically "[13]. In e-payment funds are held, processed and received in the form of digital information and their transfer is initiated via electronic payment instrument.

Note that m-payment (payment via mobile devices such as mobile phone and PDA) is also a type of e-payment since mobile devices rely on electronic data processing and transmission.

Conventional payments are enabled through cash, check or credit card whereas electronic payments are carried out by means of software, payment cards and electronic cashes. The major components of e-payment system are money transfer applications, network infrastructures, and rules & procedures governing the use of the system. Customers and merchants are the major actors of e-payment systems. Most of the time, banks and trusted third party (TTP) or intermediaries may also participate in e-payment systems.

Electronic payment is not a new phenomenon. The use of electronic networks for trade began in the early 1970s in the financial sector. Some of the first applications involved Electronic Funds Transfer (EFT) - the movement of money between financial institutions via telecommunications networks. Even Automated Teller Machines (ATMs), beginning in the 1980s, are a form of electronic payment; every time the customer uses the ATM, it involves a transaction made over a computer network [14].

E-payments greatly increase payment efficiency by reducing transaction costs and enabling trade in goods and services of very low value. They may also increase the convenience of making payments by enabling them to be made swiftly and remotely from various devices connected to global networks.

However e-payments have many challenges. For instance, e-payments that are based on digital cash have a problem of double spending. E-payments can also
generate information, which can be used for other purposes (e.g. for analyzing customer behavior, for investigations, etc.), which violates the rights of privacy. A review of major e-payment system is presented below.

2.2 Review of Major E-payment Systems

Currently there exist more than hundred e-payment systems [15]. Some e-payment systems are simply electronic versions of existing payment systems (e.g. online credit card). Some others are based on digital currency, which enables storage and exchange of values digitally. Digital currency has got some similarity with real money such as privacy and transferability.

Although electronic payment is used for different purposes, its main use is for e-commerce. In fact, e-payment is a crucial component of e-commerce. A review of the common e-payment systems is presented below.

2.2.1 Online Credit Card Payment System

Online credit card payment system is the most common type of payment system for e-commerce. A customer who wants to use a credit card for e-commerce transaction will be requested to provide his credit card information by the merchant. After the credit card information is received, the merchant's software will contact a clearinghouse. The clearinghouse authenticates the credit card and verifies the account balance by contacting the bank, which issued the credit card. If the credit card is approved to be valid for the transaction, the issuing bank credits the account of the merchant at the merchant’s bank. The merchant then notifies the customer that the payment has been made. The actual transfer of money from the credit card issuing bank to the merchant happens in hours or days.

Using credit card for online payment has got a number of limitations. The most common limitations are security and transactional cost [16]. Security issues are discussed in Section 2.6. Merchants are forced to pay from 2 to 5% of the purchase and from $0.20 to $0.30 per transaction. This high transactional cost makes online credit card payment inappropriate for micropayment. Merchants also face a risk since consumers can repudiate charges once goods have been delivered to them.
2.2.2 Electronic Payment based on Trusted Third Party

Since there is no face-to-face interaction in most e-commerce transactions, the payment system must be strongly secured. Trust is also another important factor that has to be considered. Towards this end, most electronic payment systems used for e-commerce are based on the idea of Trusted Third Party (TTP). TTP provides trust, security, identification and authentication, which are highly desirable in these kinds of payment schemes [17]. The specific role of the TTP varies from one payment system to another. In some payment systems such as CyberCash the role of TTP is limited to serving as a channel of communication between the open Internet and closed financial networks. In other systems, such as PayPal and First Virtual, both buyers and sellers have to open account in the TTP and transfer money into their TTP account. Some common payment systems based on TTP are reviewed below.

A) First Virtual

First Virtual, a San Diego-based company, was founded in 1994 to develop and market a system on the Internet [18]. First Virtual is based on the existing credit card payment system. Before starting to use First Virtual, both the merchant and the consumer have to register with First Virtual. The consumer and the merchant send their credit card information through telephone or fax. After that, both will receive the First Virtual pin number using e-mail which substitutes credit card number for online purchase.

To purchase something, a consumer presents his pin to the merchant, who then connects to First Virtual for verifying the pin's validity. First Virtual then sends an e-mail message to the consumer asking if he is willing to pay. The consumer replies back through e-mail indicating "yes," "no," or "fraud". If the answer is yes, First Virtual charges the consumer's credit card and transfer payment to the merchant.

The security of this system depends on the difficulty of intercepting and changing e-mail. No encryption is used in the system [17]. Virtual PIN provides customer anonymity from the merchant but it is less private than traditional credit card payment since the database of the purchasing information is kept by both First Virtual and the credit card company. However, First Virtual did not succeed; the company that has been running it went into bankruptcy in July 1998.
**B) PayPal**

This payment system is initially developed for use in consumer-to-consumer (C2C) transactions [6] but it now supports business as well. PayPal is based on the existing credit card and checking payment system. The technology behind PayPal is e-mail.

PayPal is very simple and easy to use [20]. To use PayPal, users have to register and provide credit card or bank account information and e-mail address to PayPal. When payment is made, money is drawn from the credit card or bank account of the payer and is put in PayPal bank. The payee is notified via e-mail that the money is waiting. To receive the money the payee should have a PayPal account. If the payee is a new user, he has to register and get a PayPal account before receiving the money. Then PayPal will fund the payee’s PayPal account. The payee then can transfer the fund electronically to a checking account, request a paper check, or use PayPal to send the fund to someone else.

For transactions between individuals, there’s no fee associated with using PayPal. PayPal makes money on the float i.e. when money is deposited on the user's PayPal account, PayPal collect interest from it. For business accounts, merchants are charged a 2.2% discount rate plus $0.30. Today PayPal is the largest and the most popular payment system.

**C) CyberCash/CyberCoin**

CyberCash is an electronic payment system that enables consumers to transact without showing their credit card information to the merchant.

To use CyberCash, three type of software are used. The first resides at the client side, the other is part of the merchant server and the last one is found at the CyberCash site. The client side software is often called client digital wallet. The digital wallet provides the necessary encryption that secures the payment. It also provides transaction record keeping. When the purchase is initiated, the client digital wallet displays amount, name of the merchant and other information to the customer. Then the customer checks everything and approves it. Then this information is encrypted by the customer's private key and is forwarded to the merchant server. At the merchant site, the merchant software digitally signs the merchant payment information and forwards it to CyberCash with the order information that comes from
the client. CyberCash decrypts and compares the two messages and their signatures. If they match, it submits a conventional authorization request and returns the charge response to the merchant, whose software confirms the purchase to the customer's wallet software (credit card response).

CyberCash withdrew from market in 2001. Large size of customer software and little acceptance by merchants are the main cause for its failure [18].

### 2.2.3 Digital Cash

One of the earliest efforts to electronic payment is the concept of digital money or digital cash. Electronic cash or digital cash is an equivalent form of physical cash backed by real money. It enables storage and exchange of values digitally. In digital cash, funds or value is stored in electronic device in a consumer possession [21]. Electronic cash has got some similarities with real money such as privacy, transferability and convenience. Like real money, digital cash is totally anonymous. However, there is also a type of digital cash called an identified e-money, which reveals the identity of the person who first withdrew the money from the bank. But unlike real cash, digital cash cannot be instantly converted to other form of value without the involvement of a third party like bank. Privacy in digital cash is achieved using blind signature without the involvement of TTP. This is in contrast with other e-payment systems. Digital cash also differs from other e-payment systems in that what is transferred over the network in the case of digital cash is monetary value. In the other e-payment systems what is transmitted over the network is sensitive payment information such as credit card numbers, bank account information or payment authorization. Digital cash can be either online or offline. In the case of online there is a need to interact with the bank, whereas in the offline case transaction can be conducted without having to contact a bank directly.

Choi. Stahl & Whinston in [18] pointed out five desirable properties that digital cash should satisfy. These are independence, security, transferability, divisibility and ease of use. Double spending, counterfeiting, and storage are the critical security issue in digital cash. Double spending involves using particular digital money for two or more separate transactions. It can be easily prevented in online digital cash by requiring merchants to contact the bank’s computer with every sale. But, it is relatively difficult to prevent double spending in offline digital money.
Anyone who wishes to use digital cash has to first establish an account and download the digital wallet software. Then the person may request transfer of digital cash to his digital wallet. After the digital cash is in his digital wallet he can spend it at any merchant where digital cash is accepted. The software will deduct the requested amount and transfer it to the merchant. The merchant then returns the e-money and funds his account.

2.2.4 Mobile Payment

Mobile payment (m-payment) is an electronic payment done using mobile devices. One of the main uses of m-payment is in mobile commerce (m-commerce). M-commerce is the buying and selling of goods and services through mobile devices. These mobile devices include mobile phones, Personal Digital Assistants (PDAs), smart phones, and laptops. M-commerce is actually a subset of e-commerce carried out over wireless networks. SMS (Short Message Service), WAP (Wireless Application Protocol) and Bluetooth application are the technology that enabled m-commerce.

Mobile payment is started in Japan and today forms a considerable component of Japan’s economy [23]. M-payment is also common in South Korea. It is widespread in Europe compared to North America.

M-payment is used for online payments and for POS (Point of Sale) transactions. Online payment is used for the purchase of digital goods such as mobile phone entertainment (ringtones, wallpaper and so on). In Japan books, music, DVDs, fashion cloth are bought and paid via mobile phones [22]. Mobile devices are also used at POS terminals, vending machines, ticketing machines, etc. The purchase of tickets (such as rail tickets, air tickets, etc) is expected to be a major application area for m-payment [24]. Banks and other financial institutions are also exploring the use of mobile phones to broaden their business by allowing their customers not only to access account information, e.g. bank balances from anywhere, but also to make transactions via mobile phones. This service is often referred to as mobile banking or m-banking.

Generally, there are three types of m-payments [25]. The first is based on the billing system of the network operator. This method lets the user bill their purchase to their monthly carrier bill or deduct it from their pre-paid deposit. M-Pay Bill service from Vodafone and Mobilepay by Sonera are instance for this type of payment.
The second type of m-payment to use the credit card over a wireless network. The payment mechanism in this type of payment is all about secure transmission of credit card data to the credit card company. Credit card data is stored securely on the mobile phone. This is done either using a dual slot mobile phone or by employing a dual chip mobile phone. EMPS –Electronic Mobile Payment System by MeritaNordbanken, Nokia and Visa is an instance of dual chip alternative. In dual chip mobile phone credit card is stored securely on the mobile phone.

In the third type of m-payment account is held at the bank. Transactions such as transferring money between accounts and paying bills can be performed using this type of payment system. Examples are Paybox and MobiPay. The existing banking infrastructure and technology are used for this type of payment.

As compared to other e-payment systems, m-payment has got some advantages such as ubiquity, accessibility and convenience.

**2.2.5 Smart Card based E-Payment System**

Smart cards are credit card sized plastic cards that have embedded chip with microprocessor and memory capabilities. One application area for smart card is payment. In e-payment smart cards are used either as storage of money or to enhance e-payment security. To use smart card it is necessary to have a smart card reader, a hardware device that communicates with the chip on the smart card. The reader can be attached with PCs, electronic cash register, etc.

Smart cards used for storage of money are actually variations of debit cards that substitute the previous magnetic strip based debit card. These are actually stored-value cards in which prepayment or currency values are electronically stored on the card chips. First the card has to be loaded with specific amount of money. This can be done by downloading cash from the bank account. Once the card is loaded with digital cash then it can be used to pay to the merchant. The card can be recharged with more digital cash when the previous money is used up. The MONDEX electronic cash system is an instance of smart card based e-payment system. The card contains a microchip with CPU and RAM. This microchip called MONDEX e-purse contains MONDEX values. MONDEX can be used over a standard phone line, via the Internet or any other digital communication means [26].
Smart card is famous in Europe. It is widely used in countries such as France and Germany mostly for public phone. It is also common in Japan and Singapore. Since credit card is widely used in USA, usage of smart card is quite limited.

The benefit of smart card is highly dependant on the availability of smart card reader [14]. Both the customer and the merchant must possess the smart card reader. For instance, MONDEX requires its client to use MONDEX-compatible phone or reader in order to download cash from the issuing bank. In fact, the use of smart card reader is seen as a reason that hinders the wide acceptance of smart card [28].

2.2.6 Electronic Billing Presentment and Payment

Bills, particularly monthly bills, are norms of modern life. Electric bills, telephone bills, etc. are some instances. Bill processing is costly [29]. From the time the bills are issued to the time they are paid, a substantial amount of cost is incurred.

Electronic payment systems reduce considerably the cost associated with paying bills [29]. Electronic Billing Presentment and Payment (EBPP) are online payment systems for monthly bills. EBPP enables consumers to pay their bills by electronic means after they view their bills electronically.

Actors for EBPP include customers, commercial banks and third party processors. Third party processors facilitate bill presentation and payment. Some third party processors present the bill in web sites and allow their customers to view and pay their bills. Others even go further and allow collecting bill from several sources and presenting all in the web sites for viewing and payment.

2.3 Impacts of E-payment

Some researchers such as Clark (1997) discuss the impact of digital money (encompassing stored-value cards based on chips, plus net based payment mechanisms) as follows [31].

2.3.1 Impacts on Consumers

E-payment offers substantial advantages to net-dwellers in the form of enhanced convenience, timesaving, and the ability to buy and sell in many market places, and in the emergent market space.
For non-net-dwellers, however, there may be equity disadvantages if digital money significantly displaces existing payment mechanisms. This can be evidenced by the unavailability of credit cards to members of lower socio-economic groups-the information-rich/information-poor dichotomy.

Moreover, there is a considerable risk of greater intrusions into individuals' behaviors by financial service organizations, and by government surveillance apparatus that stands close behind them. Information privacy protections are absent in many cases. Electronic transactions between citizens and governments render the opportunity for the latter to collect ‘customer’ information that can be used as an important input to operational and policy decision-making. Billing transactions serve as a useful source of information that allow strategic planners identify and analyze transactions to locate key trends and unmet service needs, and on the bases of this, determine the future priorities for future attention.

For the private sector, that information is an increasingly significant source of business advantage. Online identification technologies have, thus been sophisticated allowing access to individuals personal details, purchasing history and commercial value.

From the citizen's point of view, however, electronic transaction provides an instant window on their details threatening their personal privacy. The increased data intensive relationship between individuals and the organizations with which they deal (Clark uses the term dataveillance) might well result in very substantial transparency of consumers’ economic behavior. This will enable marketers to manipulate consumers. People's behavior will also become more transparent to government agencies, opening them up to greater oppression and repression. The financial trouble to which the government will be immersed by the shrinking tax-base will inevitably result in attempts to apply dataveillance capabilities yet more energetically. This will in turn drive those evading tax further into the black economy, and engender distrust in government among the population generally.

Some methods have been devised that provide anonymous digital payment, or in which one side of payment is anonymous. Clark holds it is important that these alternatives be available but reminds that there is real public interest in having some degree of traceability of funds flows. Hence, he recommends much more effort need to be invested in pseudonymous electronic payment mechanisms, which provide an indirectly identified trail. Hence, there is a need to establish technical, organizational
and legal measures to protect the means of linking the indirect identifier to an individual person.

### 2.3.2 Workplace-Impacts

The general tendency towards substitution of labor-intensive work by 'high-tech/low-labor' processes is also being enhanced by digital money. The workplace impacts include.

- Fewer people will be employed in the delivery of payment services;
- The posts that remain will demand greater educational background and higher order skills; and
- The existing trend in large financial institutions away from large numbers of manned branches will be exacerbated.

### 2.3.3 Trans-, Extra - and Supra - Jurisdictionality

Significant difficulties have always existed in relation to 'trans-jurisdictional' commerce, i.e. business activities that cross-jurisdictional boundary. In some cases, in particular where elements of a transaction are quarantined in jurisdictions that do not recognize international conventions, the behavior is already effectively 'extra-jurisdictional', in the sense that it is incapable of prosecution in any court of law.

Electronic commerce in general, and digital money in particular has put increased challenge to regulatory institutions.

'Supra-jurisdictionality' implies the fact that virtual market spaces may be subject to no existing legal jurisdictions at all.

Jurisdictionally bound regulatory agencies extend their reach through bilateral agreements (such as treaties) and multilateral arrangements through international associations (such as Interpol). However, its success has been limited due to the larger numbers of countries and sub-national jurisdictions, to differences among legal systems, cultural values, religious beliefs, political ideologies and so on.

### 2.3.4 Impacts on Taxation Agencies

Expansion of e-commerce and digital money has increased tax evasion. This has the effect decreasing tax revenue.
Taxation agencies will see themselves as being forced to rely increasingly heavily on surveillance as a means of pressuring people and companies into keeping their activities visible, so that they can be made to pay taxes.

2.3.5 Impact on Monetary Policy

Copell writes that the development of the Internet-based payment systems affects the operation of monetary policy. Friedman argues that Internet related technologies could increase the speed of financial operations, which raises the issue of how and when interest rates should be set. In fact some economists have even envisaged a world where technological developments emasculate altogether the monetary control of central banks. This could occur if new technologies (and regulators) permit real time pricing and exchange of goods across the Internet without the intercession of an independent monetary system administered by a central bank. In such an environment the government earns no seignorage and would no longer be able to provide liquidity support by printing money [8].

More likely to develop without supplanting central banks, are electronic money (digital money) systems. If such systems manage to deal with security and privacy issues, they could gain sizable share of the payment system. Their close substitutability with other payment instruments raises issues about the definition of monetary aggregates, their stability, and the ability of central banks to control money supply. Another equally important concern with electronic money is the possibility that they will be used for money laundering [32].

2.4 Framework for E-payment

Electronic payment service is offered by service companies called Payment Services Providers (PSP). These companies provide payment procedures and associated services to customers and merchants. Banks are major participants in the e-payment system. Infrastructure providers, which mainly are ISP and mobile carrier providers, are also involved in e-payment. Note that PSP does not always have to be an independent instance. One of payment participants can take over the role of providing payment services - typically a bank or infrastructure provider (ISP, mobile phone carrier). This section provides common framework for e-payment services.

Online credit card payment is the most common type of e-payment. This type of payment is well known in USA and Europe. Online credit card payments are Internet
based payment systems which involve the user of the credit card, the card issuer bank, the merchant, and acquirer bank. Internet and closed financial networks are the medium of communication used to transfer credit card and payment information. Communication between banks is done through closed financial networks. But communication with the user is done via Internet.

In USA online credit card payment accounted for 95% of all online payment in the year 2000 [33]. Most of the other e-payment systems are based on credit card (e.g. PayPal). Secure transfer of credit card information is a big security challenge that prevents users to use credit card online.

The dominance of credit cards is also true Europe-wide [35]. These credit cards are either international or local. For instance, in Finland both Visa card and domestic credit cards are commonly used [36].

Online credit card payment or e-payment systems based on credit card are not suitable for Africa [37]. This is because the penetration of credit card is low in Africa. Credit card usage depends mainly on bank accounts. But most citizens of Africa do not have bank account.

Online account-based e-payment system is another type of payment system that is common both in Europe and USA. In this type of payment system, users are required to set up and fund an e-payment account with the service provider which can then be used to make instant online payments to any other user. The payer is expected to know only the e-mail of the recipient. The recipient can receive the money either electronically or can receive it through check. PayPal is an instance of this type of payment. In England Moneybookers and NatWest FastPay are instances of online account-based e-payment.

Mobile devices and mobile phone carrier provide a framework for e-payment. This type of e-payment called m-payment is common in Europe and East Asian countries such as Japan and South Korea. Mobile phones can act as an access channel through which transactions can be initiated and authenticated.
2.5 Legal Framework for E-commerce

Various attempts have been made to create an enabling regulatory environment for e-commerce with crucial implications for e-payment. The following subsections discuss the United Nations and SADC model laws for e-commerce.

2.5.1 UNCITRAL Model Law on Electronic Commerce (1996)

The General Assembly created the United Nations Commission on International Trade Law (UNCITRAL) by its resolution 2205 (XXI) of December 1966. The mandate of the commission was to further the progressive harmonization and unification of the law of international trade and in that respect to bear in mind the interests of all peoples, in particular those of the developing, in the extensive development of international trade.

The UNCITRAL formulated a model law on e-commerce in 1996 [38]. The need to formulate model legislation arose in response to the fact that in a number of countries the existing legislation governing communication and storage of information is inadequate or outdated because it does not contemplate the use of electronic commerce. In some cases, existing legislation imposes or implies restrictions on the use of modern means of communication, for example by prescribing the use of ‘written’, ‘signed’ or ‘original documents’. Moreover, the model law is envisaged to help remedy the problems that stem from the fact that inadequate legislation at national level may create obstacles to international trade.

2.5.2 SADC Model Law on Electronic Transactions and Data Protection

The SADC draft model law [39] is an initiative sponsored by the United States Agency for International Development (USAID) to develop common legal and regulatory framework to assist the Southern African Development Community (SADC) member countries interested in adopting or enacting legislation, regulation and policies related to electronic commerce. This is an integral part of the need to start building an appropriate legal framework to facilitate ICT development
expressed in the SADC policy guidelines of 2000. In August 2001, the Heads of State of all the 14 SADC states declared to develop a model law for e-commerce in the region. The draft version was tabled and discussed at the SADC Workshop on Harmonization of E-commerce laws held in Johannesburg, South Africa on 24th and 25th November 2003.

The need to harmonize e-commerce laws in the SADC member countries arises from the following reasons according to the report on the workshop.

- It is critical that e-commerce laws be introduced to enable SADC Member Countries to globalize and leapfrog into the Cyber Age
- Borderless e-commerce is a reality and it would be better for legal certainty and facilitation of international trade if the laws of different countries were similar as possible so that they present few surprises to those who embark on e-commerce in any part of the world.
- Uniform laws throughout the SADC Member countries would allow them to learn from each other's experiences in the implementation and enforcement of such laws.

The SADC Model Law is not intended for adoption in whole or in part by SADC countries; instead, it presents a range of policy options that a country must consider as it contemplates legal reform in the information technology sector. It is no also claimed this range of options are exhaustive depending on the needs of the particular jurisdiction.

One of the basic principles of the model is Functional Equivalence. This involves reference to legal situations known in the world of paper documents in order to determine how those situations could be transported, reproduced or imitated in a dematerialized environment. For instance, Article 7 focuses upon the two most basic functions of a signature- to identify the signer and to indicate the signer's approval of information being signed-and establishes the requirements which would have to be met by any electronic signature technique in order to satisfy a legal requirement for signature.

The second basic principle is Media and Technology Neutrality. The rules of the Model Law are 'neutral' that is, they do not distinguish between types of technology and could be applied to communicate and storage of all types of information.
The third basic principle of the Model law is *Party Autonomy*. The Model law recognizes the importance of contract and "party autonomy." On the one hand, its non-mandatory provisions leave the parties free to organize the use of electronic commerce among them. On the other hand, some of their Mandatory provisions stipulate agreements concluded between two parties to be taken into consideration in assessing whether the nature of the methods used to ensure, for example, the security of messages is reasonable or "appropriate for the purpose".

The core provisions of the model law try to address issues pertaining to legal recognition of electronic data, contracts in electronic form, modifying the requirements of ‘writing’ and ‘original’, electronic signature, admissibility and evidential weight of data messages and others. This has the power to counteract some of the most important legal impediments of e-commerce and e-payment.

### 2.6 Challenges of E-payment

#### 2.6.1 Security

One of the biggest challenges of e-payment is to ensure its security. Securing the payment process involves authenticating both the customer and the merchant and protecting the information to be transmitted from interception. In addition a means must be provided that prevent repudiation both by the merchant and customer once the payment process has taken place. E-payment systems have to take into account the need of multilateral security i.e. security needs of all participating parties in the e-payment system must be given due attention. An e-payment system that is not secured may not get trust from its users. Trust is one of the crucial factors for the acceptance of e-payment system. The next section discusses major security challenges of e-payment system.

1) **Major Security Challenges of e-payment system**

   A. **Disclosure of private information**

   In e-payment there are many ways in which private information may be accessed by attackers. For instance hackers may intercept network traffic to get confidential data. It is also possible to access private data stored on a computer connected to the Internet. This data could be used to make fraudulent transactions that could lead to a loss of money.

   B. **Counterfeiting**
Counterfeiting is the creation of new data or duplication of existing data, which are technically valid but not legally admissible. Cloning of e-money for double spending and creation of fake accounts are example of counterfeiting. One popular form counterfeiting attacks is duplication of electronic data from a payment cards (e.g. ATM card) which is used, create duplicate cards and withdraw money from the accounts.

**C. Illegal alteration of payment data**

Illegal modification of payment information may result in loss money. This may again results in the loss of customer confidence. Alterations could be made to the transaction account numbers resulting in misdirected payments, to the payment amounts or to electronic balances on electronic.

Another challenge in e-payment includes usage of a fraudulent web site by an attacker to collect credit card number and other personal and/or financial information.

**II) Approaches for enhancing e-payment-related security**

The most common method of securing e-payment involves the use of technological means such as information security functions (cryptographic-based technologies like encryption, digital signature, etc). Since securing the payment system will reduce its efficiency by making it slower, compromise has to be made between security and efficiency. Some of the common technological means securing e-payments are discussed below.

**A. SSL**

As the Internet is insecure communication channel many attempts have been made to make it secure. SSL is one of them. SSL (Secure Socket Layer) is security service used to secure the Internet mostly HTTP. SSL secure Internet communication between network applications, providing privacy, authentication and integrity. SSL employs encryption, digital signature and message digest to provide security. Most e-payment security strategies are based on SSL.

**B. SET**

SET (Secure Electronic Transaction) is an open standard developed by Master Card and Visa in order to provide a solution for security problems for online credit card
payment system. Unlike SSL, SET is a payment protocol that enables to authenticate both the merchant and the customer. This is done by providing a digital certificate both for the merchant and the customer. SET provide strong security as compared to SSL. For instance it is difficult to authenticate clients in SSL, but this could be done in SET. Despite its strong security features SET did not found acceptance. In addition to the merchants users are expected to have digital signature signed by well known certificate authority. But this does not seem feasible.

**C. 3D Secure**

SET was too complicated and required the cardholder and the merchant to download 5MB client software. 3D Secure is Visa alternative to SET. The main idea of 3D Secure is to authenticate cardholders without a certificate. When authentication is required the merchant software redirects the user of the card to the issuer bank. The issuer bank will then pop up a window to the cardholder indicating which merchant is asking for authentication and for what amount. The issuer bank authenticate the user by “shared secret” that is only known by the user and the issuer bank, in addition to the normal password and user name. Issuer bank may have the option of authenticating their clients by smart cards. If the authentication is valid then bank sends a message to the merchant saying the transaction is approved.

Mobile 3D Secure specification is Visa’s 3D specification for payment made over mobile phones and other mobile devices. According to Visa Mobile 3D Secure specification extends payment authentication initiatives into m-commerce, enabling Visa card issuer to validate the identity of their cardholders in real time.

Merchants are also encouraged to accept this payment protocol as liability for charge backs (cases in which consumers denies purchase billed to their credit card) is shifted to issuer bank. Since it gives cardholder greater confidence and it does not require the customer to download special software, cardholder will benefit from it.

**D. Smart Card Security**

Smart cards provide a strong security means. Data stored on smart card is encrypted and cannot be accessed without the correct password/PIN. Some smart cards even have a cryptographic processor, which provides sophisticated security features.
Nowadays magnetic strip cards (credit card, debit card, etc) are being replaced by smart card.

Technology without proper organizational policy and procedure does not solve security problem associated with e-payment. Proper policy and procedure must be in place to ensure that technologies provide the maximum possible security. Government is also responsible to pass the required law and investigate and prosecute violators of the law.

### 2.6.2 Infrastructure

The other challenge for e-payment is proper infrastructure. For the effective deployment of e-payment, it is necessary to have a reliable and cost effective infrastructure that can be accessible to the majority of the population.

The most common communication infrastructure for e-payment is computer network such as Internet. Most e-payment systems use Internet to communicate with their customers. The other communication infrastructure available for e-payment users is the mobile network used for mobile phone.

Automating the banking activities is another prerequisite for e-payment system. Closed financial network that links banks and other financial institutions is necessary. This network is usually used between banks or other financial institution for clearing and payment confirmation.

Both the mobile network and Internet are readily available in developed countries. Users in these countries do not have problem associated with communication infrastructure. In Africa both mobile networks and Internet are not easily accessible. Poor communication infrastructure is one the reasons that hinder the e-payment system in Africa. User access devices such as PC and mobile phone are not also readily available in Africa, another reason that hinders e-payment in Africa.
2.6.3 Regulatory and Legal Issues

National, regional or international set of laws, rules, and other regulations are important prerequisites for successful implementation of e-payment schemes. Some of the main elements include rules on money laundering, supervision of commercial banks and e-money institutions by supervisory authorities, payment system oversight by central banks, consumer and data protection, cooperation and competition issues [40]. The virtual and global nature of e-payment also raises legal questions such as which jurisdiction will be competent and about applicable laws in disputed cases, validity of electronic data, electronic contracts, and electronic signature. Moreover, a legal and regulatory framework that builds trust and confidence supporting technical efforts to meet the same is another important issue that needs to be addressed.

National regulatory and legal framework that is inline with regional and international agreements is crucial in creating a certain and reliable environment. Adopting model laws at global level such as the UNCITRAL Model law on E-commerce (1996), UNCITRAL Model law on E-signatures (2001) and at regional level such as the SADC Model law on Electronic Transaction and Data protection can help the purpose.

2.6.4 Socio-Cultural Challenges

Cultural and historical differences in attitudes and the use of different forms of money (e.g. use of credit card in North America and use of debit cards in Europe) complicate the task of developing an electronic payment system that is applicable at international level. Difference in the degree of the required security and efficiency among peoples of different cultures and level of development aggravates the problem.

Consumer’s confidence and trust in the traditional payment system has made customers less likely to adopt new technologies. New technologies will not dominate the market until customers are confident that their privacy will be protected and adequate assurance of security is guaranteed. New technology also requires the test of time in order to earn the confidence of the people, even if it is easier to use and cheaper than older methods [43].

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3. Electronic Payment in Africa

E-payment in most African countries is either nonexistent or practiced in limited circumstances. Most African countries lack the infrastructure and proper legal and regulatory framework for e-payment. E-payment infrastructure such as Internet is not widely available in Africa. Bank and other financial institutions are not adequately automated to enable e-banking and e-payment. Legal and regulatory framework is also nonexistent in most African countries. However, some African countries such as Tunisia and Egypt have adequate infrastructure with proper legal and regulatory framework for e-payment and e-commerce in general.

In this section, we provide a brief account of the challenges facing e-payment in Africa. We also provide some good e-payment initiatives in two African countries. Finally, we look at efforts exerted to promote e-payment in the European Union from which Africans can learn.

3.1 Challenges of E-payment in Africa

The African e-business environment has a crucial missing component, electronic payment. Electronic payment is very limited in Africa. Many put this blunt fact as one of the major barriers for the development of e-commerce in the continent.

ADF 99 has come up with the following barriers for the introduction, adoption and growth of e-payment in the African context [41].

♦ Most banks in Africa do not deliver credit cards. People usually have to open a bank account outside the continent in order to get a credit card.

♦ Behavioral constraints: The fact that the African Society is cash-based, people are accustomed to using cash for most of their transactions

♦ Banks attitudes: African banks are very conservative; they use very few innovative products and marketing techniques.
Lack of confidence: the security issue is one of the major challenges in the development of e-payments in Africa.

Ndiaye [42] also presents the inadequacy of the financial environment as one of the major hindrance for the development of e-commerce in Africa. He views the e-payment and funding issues from the vantage point of governments, the private sector, banks, and consumers. Low level of credit card access in Africa is one of the impediments of e-payment. This in turn is attributed to lack of government policy on credit card, lack of credit card initiatives from the private sector, conservatism (lack of competition) among banks, and high risk for consumer as well as low use of banking facility.

Lack of local or regional e-payment system is the second reason for e-payment mal-performance. This is attributed to lack of policy, weakness of regional business organizations, and weakness of regional financial cooperation.

Lack of venture capital for E-business is the third impediment. The African governments have done little to set up efficient policy to promote or attract venture capitalists. The private sector is less aware and the banks have little interest in this type of activity.

Lack of e-payment infrastructure such as Internet and closed financial networks, is another challenge.

3.2 Some E-payment Initiatives in Africa

Although in general African e-payment system is not well developed, there are some African countries which have shown remarkable progress in e-payment and e-commerce. Particularly North African countries such as Tunisia and Egypt are well ahead of the other African countries.

The Egyptian government formed the Ministry of Communication and Information Technology (MCIT) to facilitate Egypt’s transitions into the global information society. It has adopted legal and regulatory framework for e-businesses and e-commerce. A complete and comprehensive e-payment framework that allows for many payment options such as credit cards, pre-paid cards, transfer of checks, and payment on fixed and mobile telephone has already been started to develop. Telecom Egypt introduced e-billing system in 2001. This e-billing system allows customers to view and pay their monthly telephone bill online. 48 thousand online bill payments were made within 18 months of its operation. Almost all banks operating in Egypt are currently fully
automated and have core-banking applications providing SWIFT and fast cash services, as well as their own switching software for online transactions. Some banks also developed banking systems including e-banking and e-commerce. Information network linking the Central Bank of Egypt with 50 banks using the frame relay technology has been established. In addition, banks possess communication links between their branches [37].

Another country that made a considerable effort in the area of e-payment is Tunisia. The Tunisian Government has paid special attention to electronic commerce and e-payment. The Government has passed a law regarding Electronic Exchange and Electronic Commerce in August 2000. Tunisia has also taken initiatives to transform its banking system. For instance the national clearance network managed by the Société Interbancaire de Telecompensation SIBTEL links all Tunisian banks using two Fiber Optic rings, ISDN, leased lines and X.25 links [44]. Tunisia has developed a multipurpose e-payment system called e-DINAR. E-DINAR allows Internet purchasing of goods and services, ATM money withdrawal, and payment at POS. Tunisia has also developed e-payment gateway for international payment. This is an Internet payment platform certified by VISA. Other ICT based payment modes include electronic solution for domestic and international money transfer (such as Student Grant, Mandat minute, IFS, EuroGiro,); e-pension, an electronic payment platform for pension payment; Internet banking called CCPNet which allow to e-banking activates such as account checking etc [45].

**Tunisia’s e-DINAR**

Since e-payment system based on credit card is not yet suitable for African countries, Tunisia has developed an e-payment system based on prepaid virtual card known as e-DINAR. E-DINAR is a multipurpose e-payment system for Internet purchasing of goods and services, ATM money withdrawal and payment at POS. Customers fill their virtual account using refill card and by authorizing transfer from their bank account via Internet. It is also possible to fill account via ATM using VISA Card and bankcard.

E-DINAR serves people from all walks of life (students, employees, unemployed, old people, etc). It is used for payment of taxes, university fees, bills, and pensions, etc. It is also used for e-commerce and money transfer.

E-DINAR was launched in September 2000 by the National Post Office, which is also the most important bank in Tunisia. By October 2004 e-DINAR had 30 thousand users. This is a 100% increase in the number of users when compared to the previous year [46].
3.3 E-payment in Europe: What Africa could learn

The paper “e-payment in Europe” [47] presents a comprehensive investigation on retail e-payments, i.e. payments that are initiated and processed electronically.

The paper covered many initiatives on the automation of the payment transaction. E-invoicing which focuses on the automation of the billing process between the payer and the beneficiary has experienced only a limited customer adoption. E-reconciliation, which involves the electronic communication of balance and payment information from the payment provider to the beneficiary for bookkeeping purposes, is widely used between large companies and their banks. As far as e-payments, which focus on the relationship between the payer and the payment provider, are concerned, a good deal of heterogeneous initiatives have emerged. These consist of traditional payment instruments that have been adapted for e-commerce, and new payment instruments and services that have began to be adopted. Credit cards have, however, remained the single most used payment instruments on the Internet in Europe.

One of the main obstacles to the development of e-payments, according to the paper, is lack of customers trust in the initiatives. An adequate legal structure and security framework could foster the use of e-payments. The European commission has developed a legal framework related to e-commerce, which consists of a Directive to ensure free movement of online services, a Directive Covering the issuance of e-money, and a Directive for the creation of e-signatures. In these Directives, the central issue among other things has been the country of origin principle, allowing mutual recognition of licenses and supervision between countries in the European Union.

The attempt to ensure security of e-money and e-payments by implementing more stringent and consistent security requirement may be more costly for consumers,
merchants, and payment service providers; thereby limiting the adoption and efficiency of the services. Because of this possible trade off between security requirements and efficiency, the Euro system stresses the need to strike balance between the two factors.


The major objectives of the Directive include making sure that all Members States accept the legal validity of an electronic signature, and all services relating to electronic signatures can be provided on the EU market without national obstacles.

The Directive provides every kind of electronic authentication attached to or logically associated with the data to be signed, obtains legal validity. Using Public Key Infrastructure (PKI) fall under electronic signatures.

This directive has the role of lifting some of the major obstacles in e-commerce and e-payment pertaining to contracts and the requirements for ‘writing’.

African countries should do their level best to establish Directives and laws for electronic payment, banking and other relevant factors at national and regional level to obtain utmost benefit therefrom.
4 Payment Systems in Ethiopia

4.1 Traditional Payment Instruments

4.1.1 Cash

Cash is a legal tender defined by the National Bank of Ethiopia (NBE) to represent values and used as major instrument of payment. NBE has authorized Birr to be used as a legal tender throughout the country. Like in other African countries, in Ethiopia also cash is a dominant means of payment. Cash is so popular because of the following reasons.

- It can be immediately converted into other forms of money without the intermediation of any financial institutions.
- It is portable and requires no authentication.
- It provides instant purchasing power for those who possess it.
- It supports micropayment.
- Payments carried out through cash have zero transactional cost for both the payer and the payee.
- It is not required to possess bank account or use special hardware devices for using cash.
- It is totally anonymous.

On the other hand, cash can easily be stolen and is usually not convenient for large amount of transactions (e.g. you can not easily buy a house with cash). Cash also does not provide a float (the period of time between a purchase and actual payment for the purchase). It also forces the payer and the payee to physically present themselves. Thus cash is not a convenient means of payment for e-commerce.
4.1.2 Checking Transfer

Checking transfer is a fund transferred directly via a signed draft or check from a consumer’s checking account to a merchant or other individual. Checking transfer is the second most common form of payment in terms of number of transactions in Ethiopia. Though it is not possible to find the exact magnitude of percentage share of check based and cash based payments in the country, cash based payments far exceed check-based payments. Checks have the following property.

- Checks are typically used for large transactions and usually not used for micropayment.
- Checks have usually some float.
- Checks are not anonymous and require third-party institutions to work.
- Checks can more easily be forged than cash.

The check clearing office in Addis Ababa, which is run by NBE, enables a payer from a given bank to issue a check payable to a payee from different bank. This office named Addis Ababa Clearing Office (AACO) is responsible for this task. AACO carry out its duties manually. Commercial banks must deposit a certain amount of money as reserve at NBE to be member of the AACO. When checks are issued from a customer of a given bank payable to a member from different bank, money will be transferred from payer bank reserve at NBE to payee’s bank reserve at NBE.

The manual check clearing system run by CBE lags behind the automated check clearing system practiced in some African countries such as Tunisia and Egypt.

4.2 Electronic Payment Instruments

4.2.1 SWIFT

SWIFT (Society for Worldwide Interbank Financial Telecommunication) is a closed TCP/IP network used by banks and other financial institutions throughout the world. SWIFT provide a messaging service that enables to settle majority of high value payments internationally.

Banks in Ethiopia currently settle their foreign transaction payment through SWIFT. According to the information obtained from NBE (National Bank of Ethiopia), most banks in Ethiopia use SWIFT primarily for international payment.
Connection to SWIFT network is done only through a dialup connection. Banks must make a dialup call to a SWIFT server found in Brussels. This international dialup connection is costly making usage of SWIFT expensive.

### 4.2.2 Western Union Money Transfer

Western Union is the World’s largest money transfer network. It has more than 212,000 agent locations in over 195 countries. In Ethiopia there are 3 agent companies of Western Union. These are the commercial Bank of Ethiopia, Construction and Business Bank, and Dashen Bank.

In Ethiopia, money transfers is paid out in Ethiopian Birr. Maximum Principal pay out is 60,000 Ethiopian Birr per transaction in Ethiopia. Money transfer sent to Ethiopia must include test question to be answer by the receiver.

Western Union identifies and disseminate consumer Fraud Awareness for its customers to prevent fraud. Unlike SWIFT, which is used to transfer money from Ethiopia to abroad and vice versa, Western Union is used to transfer money from aboard to Ethiopia only [54].

### 4.2.3 Card Based Payments

**TOTAL Fuel Card**

In 2005, TOTAL Ethiopia has introduced Abyssinia Card, a smart card used for fuel payment. Out of one hundred-twenty TOTAL fuel stations found in Ethiopia the card can be accepted at any of the forty-five stations scattered throughout Ethiopia. The card has two options for payment: post invoiced or pre-paid.

At the fuel station, users have to supply their fuel card together with the correct PIN. The card readers at the fuel station communicate with the card and authenticate users based on their PIN. If the PIN is correct, the reader provides information such as the amount of money left on the card, whether the user is allowed to purchase fuel on that particular fuel station and other similar information. If the user buys fuel using his card, the right amount of money will be deducted from his card. Users must fill up their fuel card account once the money on the card is used up.
Fuel stations that give card payment service communicate to the main office through telephone line once a day to pass payment information. Card recharging is done by paying cash at the main office. Although the usage of smart card payment is new and TOTAL has introduced its payment card very recently, Abyssinia Card is becoming successful. Currently, only four percent of fuel payment to TOTAL Ethiopia is done through Abyssinia Card. However, ever since its introduction the number of users of the card is growing from time to time. Poor telephone infrastructure, people attitude towards new payment mechanism and lack of skilled operator at fuel station are challenges to this card payment system [48].

**Mobile Prepaid Card Payment System**

The mobile phone prepaid card payment system is a successful instance of card payment system in Ethiopia. Currently it is in use by prepaid mobile phone users. Users have to charge their phone account to get mobile phone services. Account filling is done by supplying a secret number to the payment server through the mobile phone. The secret number is found on the pre-paid phone card that the user buys from shops. This payment system is used in Addis Ababa and other major cites in Ethiopia where mobile phone services are offered. The number of pre-paid mobile phone users is increasing from time to time; in fact the number of pre-paid mobile users is greater than the number of post-paid mobile phone users.

**Credit Card**

Currently the usage of credit card in Ethiopia is very low. There is no issuer of local and international credit cards. But there are some business firms (e.g. Hotels, supermarkets, etc) that accept international credit card. Dashen Bank currently gives encashment services to VISA and Master Card users. This payment system is mainly used by foreigners and Ethiopians residing abroad as they come to Ethiopia and want to get money using their credit card. Dashen Bank only acts as a merchant accepting credit card issued by banks outside Ethiopia. But the bank is finalizing its preparation to start issuing payment cards. These cards are international payment cards like VISA and Master Card. This move, we believe, will pave the way to introduce e-payment in Ethiopia [49].
Credit Card in Ethiopian Airlines

The Ethiopian Airlines currently provides an option for its customers to buy flight tickets online using their credit card. These credit cards are international credit cards such as Master Card and Visa. Customers who prefer to pay online using credit card are required to submit their credit card upon online registration. After the customers have completed their flight details online, their credit card will be charged. Tickets can be delivered by mail, collected at the airport or issued at the city ticket office.

Since credit card is not issued in Ethiopia, this service is not widely available for Ethiopians. In fact buying flight tickets online from the Ethiopian Airlines is not available for all flights [57].

4.2.3 Automatic Teller Machine (ATM)

ATM service in Ethiopia is offered by commercial bank of Ethiopia (CBE). The service is given with eight ATMs in Addis Ababa. These ATMs enable customers to withdraw limited amount of money from their account at any time. The ATMs also enable customers to check their account balance. But depositing money through ATM is not currently possible. In order to get ATM services, customers need ATM cards and secrete PIN codes. The ATM card is a smart card used for security purpose only. The ATM card coupled with a PIN code provides state-of-the-art authentication scheme called two-factor authentication.

Since the bank has connected only six of its branches, ATM service is given only to customer of these six branches. Although there are only eight ATM currently, the bank has planned to add ten more ATMs in the near future. This is very low as compared to that of Egypt, which had 1200 ATMS in 2002.

Major challenge in the usage of ATM is the unreliable telecommunication networks which results in temporary service interruption.

4.3 Infrastructure for E-payment

ICT infrastructure is crucial for the success of e-payment. Among other things, proper information and communication technology infrastructure must be in place in order to implement e-payment system. Communication infrastructure for e-payment such as Internet, closed and secured WAN, and leased telephone lines must exist
adequately. Access devices to e-payment system such as PC, mobile phone and other Point of Sale (POS) devices (for instance ATM) must also be easily available.

This section provides explanation about ICT infrastructure for e-payment in Ethiopia. The first subsection discusses about problems in e-payment due to poor ICT infrastructure. The next subsection focuses on measures that are currently being taken to enhance ICT in Ethiopia that help to promote e-payment in the country.

Due to poor telecommunication infrastructure, organizations that run e-payment system had faced a lot of challenges. ETC (Ethiopian Telecommunication Corporation), the only telecommunication provider in the country, was, so far unable to provide reliable and fast telecommunication services. Frequent connectivity failure in telephone lines and other network lines had put banks and other organizations into trouble. Low bandwidth, particularly, for Internet is the other major problem. Availability of Internet especially at peak hour is also low.

Organization that run e-payment system also face power problem. The frequent electric power disturbance has forced these organizations to buy generators. This has increased their operational cost.

The above problems are some of the reasons that hinder e-payment expansion in the country. But, this condition is currently changing. Both the government and the private sector are in the process of expanding their ICT infrastructure.

Currently, the government is doing some good work to expanding ICT usage in Ethiopia. Very recently the government has passed the national ICT draft policy for the country. One of the top priorities in the draft policy is the establishment of national information infrastructure. The policy states the role that national ICT resources play in building government capacity that would help to bring the desired development in the country [50]. In line with this, ETC is making big effort in expanding the country’s ICT infrastructure. ETC has already deployed high-speed network in the country (broadband and multimedia networks). The capacity of Internet has also grown in terms of bandwidth, coverage, and availability. The box below provides some explanation about the current efforts being done by ETC in expanding ICT infrastructure in the country.
ETC is currently in the process of transforming the telecommunication infrastructure of the country that was a major bottleneck for a long time. ETC is implementing state-of-the-art telecommunication infrastructure that provide national information link. Broadband Internet and countrywide broadband data and multimedia networks are the major ETC projects.

Internet capacity has increased both in terms of bandwidth and coverage. The present 52Mbps international Internet connection speed is expected to increase when the fiber connection to a neighboring country is completed. The Internet service has now expanded throughout the country. Internet availability for dialup users has also increased since ETC has increased its modem pool.

ETC has also introduced broadband multimedia and data service networks throughout the country. The backbone of this network consists of a fiber optics link with a speed of up to 1Gbps covering major roads in the country. Network nodes connect to this network through ADSL and fiber to home starting with a speed of 64Kbps.

Network infrastructure is an important factor for e-payment system. The current efforts made by ETC in the area of network infrastructure provide an enabling environment for e-payment.

The government is also trying to introduce e-government in the country. Woredas which are basic governmental administrative body near to their citizens are connected through broadband networks called WoredaNet.

The Ethiopian Customs Authority has also computerized its custom management system. The authority has connected its ten customs offices in the country for this purpose. This automation will facilitate the collection of custom duties efficiently at various sites.
This and other similar efforts made by the government to introduce e-government will help in creating on-line awareness that would create a favorable environment for the enhancement of e-payment in Ethiopia.

Other important factor for the expansion of e-payment is e-payment access devices that allow users to access e-payment services. Although POS devices such as ATM are not widely used, payment access devices such as personal computer and mobile phone are becoming common in Ethiopia. Personal computers are common in offices and schools. There are also many Internet café in Addis Ababa. Regarding mobile phone, ETC is making an effort to expand mobile phone usage throughout the country.

Many banks in Ethiopia do not have appropriate infrastructure for e-payment. For instance CBE, the biggest state owned bank in the country, connected only six of its branches. This network is used solely for ATM services. There is also no closed financial network between banks. But the move by Dashen Bank to introduce payment card service in Ethiopia is encouraging.

### 4.4 Legal Framework

A comprehensive legal framework aimed at 'facilitating' instead of 'strictly regulating' e-commerce is a crucial prerequisite for its growth. Growth of e-commerce and ICT play a key role in leveling the field for the developed and developing countries. Hence, efforts are under way to create a conducive, facilitatory legal regime as well as technological infrastructure for e-commerce in different countries.

Ethiopia has not yet set a comprehensive legal framework for e-commerce in general and e-payment in particular. According to information obtained from the Justice and Legal Research Studies Institute (JLRSI) of Ethiopia, the reason for not yet establishing the legal framework for e-commerce and e-payment is mainly the inexistence of large pool of e-commerce activities. Moreover, the existing meager amount of e-commerce activities can be well served by the Ethiopian Civil Code of 1960, which is open by many standards to incorporate technological and institutional improvements. But some African countries such as Tunisia and Egypt have developed a comprehensive legal and regulatory framework for e-commerce. Tunisia has already passed detailed and progressive Internet legislation.
Specifically, with regard to the legal framework for payment in Ethiopia, the National bank of Ethiopia does not clearly state its role to oversight and regulate payment system in Ethiopia in its governing legislation [51].

The legal framework governing payments in Ethiopia has some major shortcomings such as lack of significant penalties for check frauds and other abuses and lack of adequate provision for electronic payment [51].

Recently, the Ethiopian government has identified the development of National Information Infrastructure (NII) as one of the national strategic components to make change and improve the determinants in socio-economic performance and had developed a draft policy document to this end. One of the goals of the policy document is to establish information infrastructure comprising broad band communication backbone and access network supporting integrated and multimedia services, and also distributed data ware houses and services to cater to the needs of trade, commerce, industry and tourism and to enhance the delivery of government services. One of the national strategies to this end is the formation of a set of national legal frameworks pertinent to the development of information resources and services for integration in the national development policies.

Though there is no full-fledged legal framework for e-commerce and e-payment, information obtained from Dashen Bank, Commercial Bank of Ethiopia, and Total Ethiopia, indicates that they have not yet faced major legal and regulatory problem. However, they express fear that as they continue to introduce and adopt newer technologies in automating payment and other tasks, the aforementioned limitations may arise. Hence, they endorse that there is a need to have a comprehensive legal and regulatory framework at national and global level. A safe and efficient national payment system is essential for sound banking and financial market.

The Ethiopian Civil Code addresses some of the most important legal issues pertaining to electronic transactions. We review the provisions of the Ethiopian Civil Code in view some of the issues raised in the UNCITRAL Model law for E-commerce.

**Formation and Validity of Contracts in Ethiopia**

According to the Ethiopian Civil Code [52], a contract is an agreement where two or more parties create, vary or extinguish obligation between them. It stresses on communication of an offer to the offeree and the acceptance by the latter. With
regard to formation and validity of contract, the Ethiopian Civil Code, Article 1719 (1) reads, "Unless otherwise provided, no special form shall be required and a contract shall be valid where the parties agree." This sub-article stipulates that except for some instances where a special form is prescribed by law, the Ethiopian law addresses the issue of freedom of form. This has the role of addressing the problem that would arise for e-commerce and e-payment if contracts required the form be hand written and signed.

This is in line with the possibility of forming contracts by means of data message and rendering validity for the same stipulated in Article 11 of the UNCITRAL e-commerce model law.

Regarding the requirement for signature, Article 1727 and 1728 of the Ethiopian Civil Code stipulates that contracts required to be in writing shall be supported by a special document signed by the parties bound by the contract and be attested by two witnesses. Affixing the party’s handwritten signature or a thumb mark shall carry out the signature. No provision is given as to the acceptability of electronic signatures. Hence the provision in the UNCITRAL model law to accept e-signatures is not addressed in the Ethiopian Civil Code.

Other crucial elements for the success and wide use of e-payment include explicitly stated privacy and data protection laws. Such are missing in Ethiopia currently. The government, however, has given such security issues due regard in its ICT policy. The Ethiopian Civil Code is being revised and provisions pertaining to payment reform have been suggested to be incorporated in the upcoming revised Commercial Code [55].

4.5 Socio-Cultural Aspects

In their attempts to introduce and adopt new technologies such as electronic payment systems, the Dashen Bank, Total Ethiopia, and the Ethiopian Commercial bank, have faced some problems related to social and cultural attitude. The result of the interviews we conducted with these companies indicate that there is resistance to changes among customers, and to some extent staff members. This is attributed to lack of awareness on the benefits of new technologies, fear of risk, lack of training, and tendency to be content with the existing structure instead of looking for better opportunities (conservatism). All the three companies underline, however, that the trend is promising.
Ethiopians today, in spite of the widespread poverty in their country, are making use of some of the recent developments in ICT. An astounding example is their use of mobile text messages for their 2005 election campaign.

Lately private and public colleges offering courses in information and communication technology are mushrooming. This above and beyond arming the trainees with the necessary skills and capacity to operate in ICT environment will play a crucial role in creating an ICT aware and user society.

<table>
<thead>
<tr>
<th>Genuine Leather</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genuine Leather craft is an Ethiopian seller of fashionable leather clothing targeting Ethiopians in the Diaspora. They classify orders they receive in terms of the volume involved. They can entertain both individual order and bulk order for delivery to anywhere in the world. However the terms of payment, delivery and other conditions of trade are different.</td>
</tr>
<tr>
<td><strong>Bulk Purchases</strong> are orders for commercial purposes the minimum quantity of which is 25 pieces per style. Payment is conducted by irrevocable confirmed letter of credit in their favor through the Commercial Bank of Ethiopia, Addis Ababa Meskel Square Branch payable at sight upon presentation of the shipping documents.</td>
</tr>
<tr>
<td>As far as Private purchases are concerned, individual buyers are welcome to shop online. Genuine Leather can accept an order even for one jacket and send it to the buyer by courier service any where in the world. Prices include worldwide shipping! Clicking the Order icon and completing the forms that follow make credit card purchases. Moreover, other means of payment such as wire transfer via Fax to their account in Commercial Bank of Ethiopia is also possible [53].</td>
</tr>
</tbody>
</table>

### 4.6 Challenges of E-payment in Ethiopia

E-payment in Ethiopia is has some major challenges. Some of these challenges are the following.

- Poor telecommunication infrastructure
- Frequent power disruption
- People are resistant to new payment mechanisms
- Lack of skilled manpower
- Unavailability of payment laws and regulations particularly for e-payment
5 Conclusion and Recommendation

5.1 Conclusion

In the paper an attempt has been made to study mainly the opportunities and challenges of e-payment in Ethiopia. To this end, a review of the related literature, interview with open-ended questions, observation, and development of prototype for bill payment and e-commerce suitable to Ethiopia have been carried out.

Many e-payment systems have emerged since the 1980s. However, major security, infrastructure, legal, regulatory and socio-cultural challenges have characterized the systems. Some regions and counties have made some commendable efforts to address the problems. For instance, the European Commission has developed a legal framework consisting Directives to ensure free movement of online services, Directives for the issuance of e-money and Directives for e-signatures. The UNCITRAL formulated a model law on e-commerce in 1996. The SADC member countries developed the SADC Model Law on Electronic Transactions and Data Protection.

In Africa, e-payment is characterized by widespread challenges. Poor telecommunication infrastructure, limited readiness by banks, behavioral constraints, inadequate legal and regulatory framework, low level of credit card access are among the constraints that have hindered the progress of e-payment in Africa. However, it is to be underlined that there are some promising efforts in some African countries such as Egypt, Tunisia, and Morocco to lay a strong foundation for e-payment. These countries have committed huge resources towards ICT infrastructure, legal and regulatory framework for e-payment.
In Ethiopia, the study has found that e-commerce as well as its essential aspect e-payment is a recent phenomenon. However, the undergoing endeavor by some banks, and business enterprises to introduce and use e-payment is not to be undermined. As far as e-payment for bill payment is concerned except the success achieved by the Ethiopian Telecommunication Corporation by the introduction and wide use of prepaid cards for mobile bill payment, there is little progress by other companies despite a large potential demand in the country.

The major challenges of e-payment in Ethiopia include

- Poor telecommunication infrastructure
- Frequent power disruption
- People are resistant to new payment mechanisms
- Lack of skilled manpower
- Unavailability of payment laws, and regulations particularly for e-payment.

The Ethiopian government has given a considerable attention to ICT as expressed in its ICT Draft Policy. Moreover, the State owned Ethiopian Telecommunication Corporation has invested huge fund to implement state-of-the-art telecommunication infrastructure that provides national information link. This has an essential role in laying the foundation for e-payment.

The introduction of ATM with a plan to expand in the near future by the Commercial Bank of Ethiopia, the continuing effort by the Dashen Bank to introduce and issue its own international payment cards beyond the present mere encashment services of Visa and Master Cards, the success expressed by Total Ethiopia by the development and use of Abyssinia Card are witnesses of e-payment potential in Ethiopia.

In this paper we have proposed a model for e-payment that is applicable for the Ethiopian context. Two models one for e-commerce and another for bill payment have been proposed. We have also developed prototypes to demonstrate each model. Details about the models and prototypes can be referred from the annex.

5.2 Recommendation

In Ethiopia ICT infrastructure like other African countries is not well developed. This is one reason why e-payment is not expanded in the country. But the current effort
by ETC to expand the country ICT infrastructure is encouraging. The national ICT draft policy has also given great emphasis on the expansion of ICT infrastructure. Current effort done by the government to establish nation wide networks such as WerdaNet and RevenueNet need also to be encouraged and expanded.

In Ethiopia, the cost of ICT services is quite high. For instance the cost of dialup Internet is expensive. For e-payment to expand and used by considerable proportion of population, the cost of ICT has to be decreased. A way has to be created that enables citizens to get ICT services in cost effective way.

Automating banks is another important factor that fosters growth of e-payment. In Ethiopia and most other African countries banks are not automated. For instance in Ethiopia there is no financial network that links different banks. Due to this the check and clearing office run by NBE is totally manual. When it comes to ICT banks are more conservative. Banks are expected to do more in the area of ICT. It is important to introduce a financial network used for settlement and clearing purpose

Another important factor related to the e-payment infrastructure is the reliable supply of electric power. The frequent interruption of electric power is a challenge by itself. Electric power providers are expected to deliver uninterrupted power.

It is known that e-payment system need a good network infrastructure. But network infrastructure is not a must for e-payment systems that are based on smart card. This, however, entails stringent security requirement on the smart card. Abyssinia Card, a smart card payment system used for fuel purchases is an instance of e-payment system that does not involve the use of network for its operation. The only challenge in the use of smart card is the ubiquity of smart card readers. Smart card reader must be available in cost effective way.

Security is one of the important factors for e-payment system. Security is one factor that builds confidence of users. Proper security means has to be applied in the system to gain users trust. In this paper we have focused on transaction security of e-payment system, as this is the most important and the one, which can be easily
broken. But system security that takes into account the technical and organizational IT infrastructure security must also be given the necessary attention.

Users of e-payment system need to be aware of the security risk of e-payment system. For instance users should not provide their private payment information such as credit card numbers to a website that they do not know or to a website that does not have a certificate from well-known certificate issuers.

Concentrating too much on the security may reduce the efficiency of the system. Care has to be taken in this respect. Early payment systems concentrate too much on the security without giving proper attention to users’ requirements. As the result most of them did not get acceptance [56].

Clearly stated regulatory and legal framework for ICT is essential for creating a certain and reliable environment for economic agents. E-payment laws and regulations, aiming at enhancing instead of strictly regulating the same, play a crucial role in development of e-commerce. Although the 1960 Ethiopian Civil Code is open to incorporate technological changes, by no means can it be claimed adequate for the development of a full-fledged e-payment system. In fact there is a growing and urgent need to establish a comprehensive legal and regulatory structure for the growth and protection of e-commerce in general and e-payment in particular.

Moreover, growing globalization has necessitated cross border e-commerce. Its success, however, has been limited by differences in legal systems, cultural values, religious beliefs, political ideologies and so on. This blunt fact incites the need for creating legal and regulatory framework compatible with that of other countries. Adopting Model laws such as the 1996 UNCITRAL Model on E-commerce, and SADC Model LAW on Electronic Transactions and Data Protection could serve the purpose.

Still equally important to consider is the fact that Ethiopia lags behind in establishing clearly set laws related to e-transaction. These include consumer and data protection laws, privacy laws, Internet laws, and so on. These are so important that their absence could put a barricade on the growth of e-commerce and e-payment.

It is indispensable for the improvement of society’s social and economic life to raise public awareness of the benefits of new technologies such as computer enabled net-
works e-commerce, and e-payment. Schools, higher institutions and the media should give due attention as an important part of their task. Managers of financial institutions such as banks should be bold enough to invest on ICT equipment and manpower training in the field to ensure competitiveness in modern world of information. An essential aspect of this task is to invest on efficient and secure e-payment and e-banking systems.

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Annex

E-payment System Model

Both for e-commerce and bill payment web-based client/server architecture is proposed. Users of e-payment system called clients access the e-payment system through their web browsers. The server side will hold the business logic and the database. This architecture often called three-tire architecture provides flexibility, scalability and modularity. Clients need only browser in order to interact with the rest of the system. The middle-tier holds the business logic. It communicates both with the client and the database. The database, another tier, provides storage structure for persistent information. The database and the business logic may reside on the same server or in different server linked through network. The company that runs the e-payment system is responsible to implement and administer these components. The company in the case of e-commerce can be a trusted third party or owner of an e-commerce. In the case of bill payment it can be a utility company that was previously involved in issuing bills manually. Internet is the primary medium of communication between clients and the server.

In order to pay, clients must have money in their e-payment account. Clients deposit money in their e-payment account using internet cash card. Internet cash card is debit card, which is very similar to prepaid mobile phone card. Like prepaid mobile phone card, it represents a fixed value of money. It can be purchased at physical stores, supermarket, etc. Clients have to provide the secret code found on the card in order to fill their account. The cards are issued and controlled by the company that runs the e-payment system.

The next sections discuss about tools and technology used in the prototypes. For security purpose SSL has been used. Java is the programming language used to implement the business logic of the system. The web server, DBMS and related tools and technology used in the prototype have also been discussed.

Secure Socket Layer

In order to provide the desired transactional security, SSL (Secure Socket Layer) is used.

SSL is security service that is used for securing the Internet mostly HTTP. SSL secures Internet communication between network applications, by providing privacy, authenticity and integrity.
SSL provides privacy by encrypting every message transferred between clients and servers thus providing a high degree of confidentiality. SSL protocol uses a combination of public-key and symmetric key encryption for this purpose. SSL also provides higher degree of message integrity by using message digest or hash functions. Message digest provides a mechanism for ensuring a message that has not been changed in transit.

One of the interesting features supplied by SSL is authentication of servers and optionally clients. SSL server authentication allows clients to confirm a server's identity through their digital certificate. A digital certificate securely binds the identity of an entity to a particular public key. This binding is validated by a trusted third party named as certification authority (CA). A digital certificate is signed with the private key of the certification authority.

SSL has got several versions but SSL version 3 is the most widely deployed version. It is supported by all major web servers and web browsers like Netscape, and recent version of Microsoft Internet explorer. TLS (Transport Layer Security), the specification of ITF proposed in RFC 2246 is almost identical to SSL version 3.

DBMS

The DBMS used in the prototype is MySQL version 4.0.13. MySQL is a popular open source relational database management system. It can run on Windows, UNIX and Linux. It is commonly used for web-based applications.

Servlets

Java servlets are used to implement the business logic of the prototypes. Java servlets are java programs that run within web server, acting as middle layer between requests coming from a web browser or other http client and databases or applications on the HTTP server. Although there are other programming or scripting languages that provide similar functionalities, Java’s robustness, its rich APIs and its object orient nature make it ideal to develop a full-fledged e-commerce application.

Servlets run in a Java-enabled web server. Within the web server the part that is responsible to execute servlet is called servlet container or servlet engine. Servlet
engine is a single process that runs a JVM (Java Virtual Machine). Servlets are also portable. Major web servers such as Apache HTTP Server, Internet Information Services (IIS), WebLogic application server and WebSphere support Servlets.

Servlets are responsible to accept any data sent by clients. Based on the data sent by a browser the servlet performs different actions. It may interact with a database or other applications. It may invoke another servlet. Finally it may generate a dynamic html page and send it back to the client.

**Web Server**

The prototypes use Tomcat 5.0.16 as a primary web server. Tomcat can be used standalone as a web server or plugged into a web server like Apache, IIS, etc. When used alone Tomcat will be used both as web server and servlet container.

Before used as a web server, Tomcat must be configured. In this paragraph steps taken to configure Tomcat for Windows XP are explained. After downloading the binary file running the .exe version provides a typical windows installer. Tomcat installs easily and quickly using the same dialog windows as other applications. But before Tomcat is installed Java Software Development Kit must be installed. During the installation Tomcat requests the location of Java SDK. We also need to set JAVA_HOME environment variable to tell Tomcat where to find Java. This is done by adding the statement `set JAVA_HOME=c:\j2sdk1.4.0_02` in the c:\autoexec.bat file.

After this we need to make some changes to server configuration (server.xml) file. This file is located in the directory `\Tomcat 5.0\conf`. In this file we have to add our own context invoker for application to be recognized. This is done by adding the following statement near the root context invoker. The following statement will add context named billpayment.

```
<context path="/billpayment" docBase="billpayment" reloadable="true"/>
```

The next step is to create web applications. To create the web applications we have to create a directory inside the webapps directory. In this directory we have to create a directory called WEB-INF. All programs and configuration files used in the prototype are stored in this directory. One important required element in WEB-INF is the file web.xml. The web.xml file controls everything specific to the current web
application. Programs used in the prototype have to be registered here. After these configurations the web server becomes ready to accept client/browser request.

**Integrating SSL in Tomcat web server**

This section explains steps carried out in integrating SSL in Tomcat web server. To install SSL in Tomcat Java Secure Socket Extension (JSSE), server certificate keystore and an HTTPS connector are needed.

**JSSE (Java Secure Socket Extension)**

JSSE is a set of Java packages that enables secure Internet communications. These packages implement a Java version of SSL and TLS protocols and include functionality for data encryption, server authentication, message integrity, and optional client authentication. JSSE has support for built-in algorithm such as RSA, RC4, DES, 3DES, DH, DSA, SHA, MD5. JSSE has been integrated into the Java 2 SDK, Standard Edition v 1.4.

**Server Certificate keystore**

In order to implement SSL, a web server must have an associated certificate. Certificate is typically purchased from a well-known Certificate Authority (CA) such as VeriSign. Such certificates can be electronically verified. The SSL service of the Tomcat server will not run unless a server certificate has been installed. In the prototypes self-signed certificates are used. Self-signed certificate is simply user generated certificate which has not been officially registered with any well-known CA. Self-signed certificate is acceptable for most SSL communication. To generate the certificate java provides command-line tool called keytool. Keytool stores the keys and certificates in a so-called keystore. To generate the certificate the following command was executed.

```
%JAVA_HOME%\bin\keytool -genkey -alias tomcat -keyalg RSA
```

-`-keyalg RSA specifies that the RSA algorithms are used in the SSL. The keytool utility that is shipped with the J2SE SDK version programmatically adds a Java Cryptographic Extension provider that has implementations of RSA algorithms.

When the command line is executed it will prompt for general information used to construct certificate, such as company name, organization, and so on. This information will be displayed to users who attempt to access a secure page.
HTTPS connector
The server.xml file must be edited to enable https connector. By default https connection is disabled in Tomcat. In the prototype the port used for SSL is 8443 (the default port number used in Tomcat for https). For maximum security it is possible to close the connection that operates through port number 80 (non SSL web connection). But in this prototype the applications are responsible not to accept connection through port number 80.

Browser must use https instead of http to initiates SSL connections. In the prototype address like https://localhost:8443/billpayment/... are used.

JDBC
JDBC (Java Database Connectivity) is a set of classes and interface that allows access to SQL based DBMS. It allows integration of SQL statement into programming environment by providing library routine which interface with the database. The dependent part is the driver used for each database. Since the DBMS used in this project is MySQL we have used MySQL Connector/J 3.1.1 driver. This driver uses MySQL’s C API in the background to talk to MySQL. The jar file of this driver must be stored in the directory ...\j2sdk1.4.2_08\jre\lib\ext in order to be accessible.

5.4 Functionalities of the Prototype
This section describes functionalities provided by the prototypes. The first subsection describes functionalities provided by the prototype of the e-payment for e-commerce. The next subsection is about the functionalities of the prototype that is used for bill payment.

E-payment for e-commerce
This prototype provides e-payment services for e-commerce customers and merchants. Both customers and merchants need to get registered before paying or accepting money. Through the registration process the system gets basic information from the users. To get the registration page use the following URL http://localhost/projects/won/RegisterForm
Users need to provide the correct information when they get registered. After users have filled this form a confirmation page will be displayed to confirm registration. Upon successful registration the system will generate unique login id. This login id is used as primary means of identifying users of the system. After the users get
registered they can login and start to use the system. To get the login page use the following URL
https://localhost:8443/projects/won/LoginForm

After users have provided their password and login name correctly they will be directed to their home page. From their home page users can transfer to pages that enable to fill their virtual account, to pay to other user of this system or view their payment history.

Users fill their virtual account using internet cash card. After users have properly filled the secret code of the card, their e-payment account will increase based on the amount of the cash card. To avoid brute-force attack to the system, users can only make three successive attempts before their account is suspended. If users do not correctly enter the secret code in the first attempts, they will be given first warning. If they fail to enter the secret code in the second attempt they will be given final warning. But if they can’t provide the correct secret code in three consecutive attempts their account will be disabled.

In order to pay to someone users must provide the payment id of the payee and the amount to be paid. If payment is successful, a confirmation page will be presented to the payer. The payee knows about this payment by viewing his payment history.

**E-payment for Bill Payment**

This prototype provides the functionalities that enable to view and pay bills. Users that want to pay their bills using this system need to get registered first. In addition users must also get register their meter.

To get the users registration page users need the following URL
https://localhost:8443/billpayment/UserRegisterForm

To get the meter registration page users need the following URL
http://localhost/billpayment/meterRegistrationForm

After the users get registered themselves and their meter, they can login to get the functionalities of the system. In order to login users need the following URL
https://localhost:8443/billpayment/loginform

After users provide the correct password and login name correctly they will be transferred to their home page. In their home they can view any bill issued to them.
for a meter register under them if there is any. They can also fill their virtual account using internet cash card. This is similar to the prototype of the e-commerce. Their home page also provides them a link to page which enables to view and pay their bills.

**Administrative Page**

Both prototypes provide administrative pages. In the case of the prototype that is used for bill payment, the administrative page is used to generate secret code of the internet cash card and to issue new bills. In the case of prototype used for ecommerce it used to generate a secret code of the internet cash card. The password and Login Name used for this purpose are login Name= admin, password=123abc.

The URL to used to access these pages are

For bill payment [https://localhost:8443/billpayment/adminPage](https://localhost:8443/billpayment/adminPage)


**Steps needed to configure the prototypes**

1. Java JDK installations
   Download and install the Java Software Development Kit (SDK). It is best to download Java 1.4.

2. Download the Mysql- java connector, which is used to connect MySql with the Java Servlets through JDBC. The jar file must be put in  `\jre\lib\ext` of the jsdk.

3. Install the Mysql DBMS

4. Create the tables that are used in prototypes. (The scripts used to create the table is found in the root in the same directory as this file with a name

5. Install and configure Tomcat web server.

6. Copy the two folders (`project` and `bill payment`) and put them in `Apache Software Foundation\Tomcat 5.0\webapps` folder. They are already contained preconfigured so they do not need configurations.