

# Interoperable Payment Systems: Requirements Driven Architecture for Ethiopian Banking Sector

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## Abstract

Modern Payment Systems have numerous advantages over traditional retail payment systems. At present it is common to use cards on banks' ATM and POS terminals as well as other terminals deployed within and outside the country. Card based payment systems in Ethiopian banks are not interoperable. Banks only offer services for cardholders opened accounts and registered businesses in each respective bank branch. This limitation reduces the payment card system utilization and accessibilities which hinder the financial transformation of the country in moving forward from cash based to cashless economy. It also creates duplication of investment across the country with unilateral deployment of card payment systems, ATMs and POS terminals in one place instead of scattering them for ease of use and convenience of the cardholder.

Using the existing international available industry models for interoperability in its present condition has its own problems, caused by highly regulated banking practice in Ethiopia. Adapting the international practice without any local standard affects the business in terms of controlling and operational business setup. Most available models are not bank-led models; and mixed in nature comprised of mobile operator, third party processors, international, regional as well as national banks, which are difficult to implement on the existing infrastructure and environment. Payment system practice and technology implementations outdo long progression on what it reached today; hence, adapting the model as-is for existing newborn environment without the internal background assessment may affect existing operational business implementations.

To alleviate the existing issues, this paper proposed a new architectural model that supports interoperability payment card system in relation to the country's current organizational and environmental uniqueness via the method of literature and document review, questionnaire and interview with technical and operational personnel as well as cardholders to get the current practice and limitations on the existing card based payment systems.

*Keywords:* Interoperability; Payment System; Card-Based Payment System; ATM; POS

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## 1. Introduction

Payment system can be described as the systems and communications mechanisms put in place by commercial banks to provide their customers with the facilities and alternative channels to effect payments without the limitation of time and convenience [1]. These networks include Automated Teller Machines (ATMs), Point of Sale terminals (POS), Internet and online banking facilities, branch networks, and payment instruments.

Card Based Payment System is one part of payment instruments and has been widely used in developed countries for long time since a bankcard was introduced as a payment mechanism and is

rapidly expanding in developing countries with alternate payment channels [1].

According to the Institute of Electrical and Electronics Engineers (IEEE) [2], interoperability is the ability of two or more systems or components to exchange information and to use the information that has been exchanged. The term is often used in technical systems, or alternatively in a broad sense, taking into account social, political, and organizational factors that impact system performance.

Interoperability can be classified in to four layers on implementations; these are [3]; Organizational, Semantic, Syntactic and Technical layer Interoperability. Since this research work emphasized on the Organizational and Semantic Interoperability

for the existing Payment Card System, the definition and meaning of these two interoperability layers is discussed in brief.

**Organizational Interoperability:** is related to whether the participating organizations use the shared information in similar contexts of the business functions, services or business process, i.e., the shared information that impact the business activities related with business services, legal, political, and process interoperability are to be considered.

**Semantic Interoperability:** is related to the meaning of the shared information. It is the ability to automatically interpret the information exchanged meaningfully and accurately in order to produce useful results as defined by the end users of both systems. To achieve semantic interoperability, both sides must refer to a common information exchange reference model. The content of the information exchange requests are unambiguously defined: what is sent is the same as what is understood.

## **2. Background**

The current payment infrastructure is characterized by heavy use of cash for all types of payments. Although banks are extending their branch networks rapidly and the emergence of new banks is accelerated since the year 2000, access to banking service in the country is still limited. According to the National Bank of Ethiopia, in 2008, 4.3% of the population or around 20% of households have opened bank accounts. Based on this report, for example, in 2008 there was only one bank-branch for every 140,000 inhabitants, indicating that Ethiopia still remains one of the most under-banked countries in the world even by Sub-Saharan standards [4].

As a result of the rapid initiation towards the Growth and Transformation Plan and recent directives that mandated to have core-banking and modern payment systems by the National Bank of Ethiopia, few financial Institutions started to provide alternative channels to their customers in facilitating payments. Recently banks in Ethiopia started alternative channels on card based payment system and deployed systems to enable issuing and acquiring of card based transactions. However, several issues arise around interoperability and resource sharing.

Moreover, electronic payment systems are at an embryonic stage. Presently Dashen, Zemen, Wogagen, and CBE have started introducing card based payment systems independently and other banks are planning to invest in such technology. However, since the cardholder can't use other banks' networks other than the issuing bank, the current implementations on payment systems are not interoperable.

This interoperability payment process problem is mainly related to Organizational Interoperability layer as a result of lack of procedures and legal interpretation to be adopted in the processing of multiple bank payment system. Consequently a card issued to one banks' customer can't be used on other banks' ATM or POS. There is no sharing of information on the existing terminals and payment systems in similar contexts of their business functionalities, or business processes. Therefore, banks and the nation in general are wasting a massive amount of money and resources purchasing separate technologies which will serve only for the limited customer base of particular financial institutions.

The reflection of this problem is also observed on Semantic Interoperability to interpret the meaning of the transactions request from the terminals that leads to decline the transactions while attempt by the cardholder other than their banks' channel. Thus a customer more than one account with various banks will have different cards issued and linked to its account based on each bank's interest which will create technological duplication as well as inefficient functionality to the consumers in using his/her cards for payment.

Therefore, this paper attempts to study the organizational and semantic interoperability problems on the payment process and infrastructures based on requirements from the owners in the Ethiopian banking sector and workout interoperability architectural model to fill the gap that will save cost in relation to implementation time and resources.

## **3. The Proposed Solution**

In terms of the available and discussed models (business and technical), operation scope, pros and

cons explored with all possibilities and alternative solutions, the closed national switch, with the establishment of a common company to run the business of the central platform is suitable for Ethiopia. This is because of the limitations associated with both local and foreign outsourcing on open with outsourced Processing. Despite their advantages of easy implementation, the outsourcing options will not give the required level of control and flexibility on the operation of the business. Moreover, gradual learning and skill development is more attainable with the option of establishing a common company on the closed national switch, which is critical considering the sustainability of the scheme. The company can communicate with all banks' core-banking systems in the case of no EFTSwitch implementations and connect to banks with EFTSwitch that have already deployed payment card systems, and act as a third party issuer for card issuing and transactions routing with terminal deployer alternatives for the later.

The interoperability model discussed above shall be designed in such a way that it handles the interests of all banks that are on different levels in terms of card payment operations. Banks that started card payment with their own switch can easily interface to the common Switch. Banks without an EFTSwitch can use this common Switch as their switch to drive their ATMs/POSSs. Banks that want to work only on issuing cards can again use the common Switch to personalize their card and allow their customers to use ATMs/POSSs of other participant banks.

Based on the above rationale, limitations on the exiting country-specific interoperability models, output of the methodology and recommended a layered and functional architecture of Figure 1 as a contribution for the Ethiopian Banking sector on how they can interoperate and integrate their payment systems as per the proposed modalities. The basic concept of the Layered Architecture will give solution on how member banks implement interoperability with particular emphasis on Integration and Business layers.

- The authorization EFTSwitch and the card and business management interface component

interact with international card schemes for not-on-us transactions.

- All the communication between the interface and Business Logic Layer network lies in the integration layer.
- The business Layer comprises the business logic of the different interactions between member banks for billing, ATM and POS management, transactions and reconciliations, card management, and loyalty components.
- The Data layer is the last layer for which all the transactions stored and retrieved for settlement, reconciliation as well as dispute management functionalities.

The high level architectural diagram of Figure 2 reveals the logical network connectivity between participating Bank's Switch or ATMs/POSSs, international card scheme, TPP processor and ACH for clearing settlement purposes. This architectural diagram is different from others; as the result of the connectivity taken into consideration based on the existing Ethiopian banking payment system, organizational and operational scenarios.

## 4. Discussion

### 4.1 Response to initial problem

The initial problem of the statement of the research aimed to address the issue of the resource sharing and interoperability of terminals on ATMs as well as POS terminals for which the cardholder of one bank can be able to use the terminals of others. Since the proposed system uses as a common EFTSwitch, it can solve the issue of interoperability and resource sharing using the switching and routing of transactions initiated from one bank terminals to the base systems and/or terminals.

On the other hand, a customer who has more than one account maintained with various banks can use his/her accounts linked on card at any terminal for transaction mandated by the proposed common switch. This shall create efficiency in terms of functionality. Moreover, it can be able to work in two technical modalities; for those who have already EFTSwitch, and with Core-banking system that haven't EFTSwitch to eliminate the duplication of resource and maintain resource efficiency.

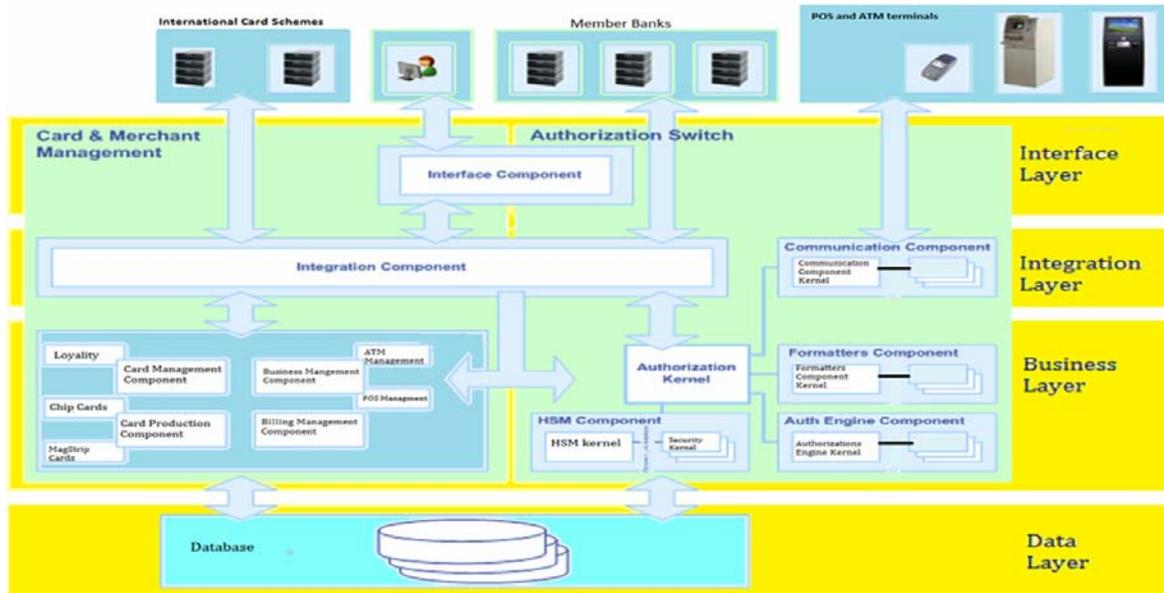


Figure 1: High Level Layered Architecture

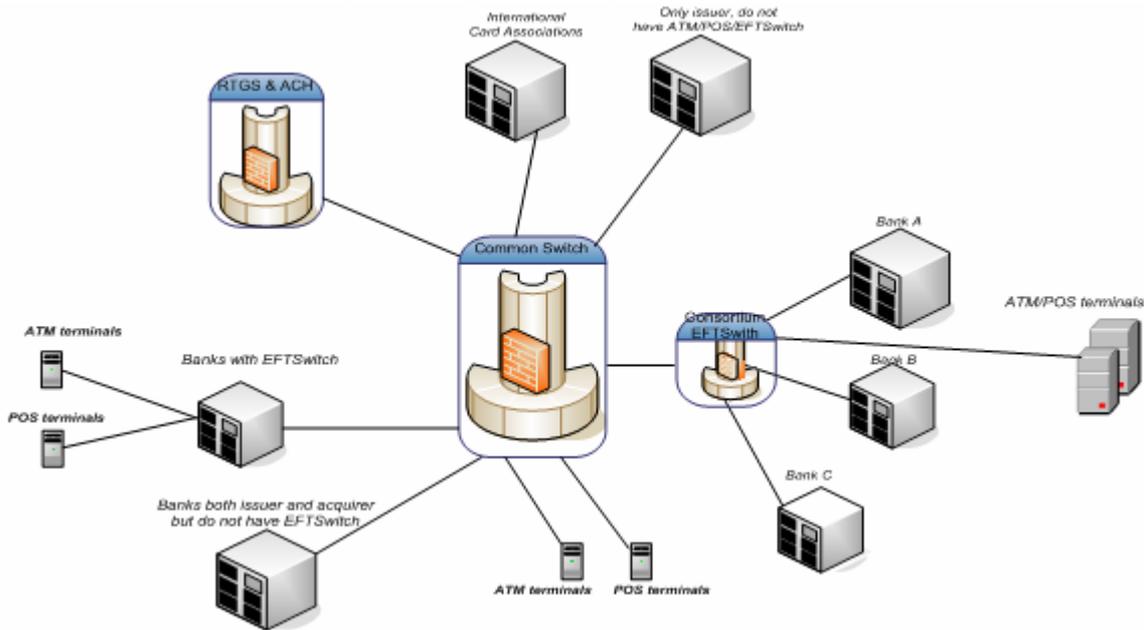


Figure 2: High level logical network Architecture

4.2 Per the technical, governance and business constrains

*Technical:* One of the technical constraints discussed was the issue of lack of knowledge and capital inadequacy to invest on the high availability and redundant payment systems. Based on this constraint, the recommended EFTSwitch will solve same by creating redundancy for those who have EFTSwitch with Stand in Transaction Processing (STIP). Additionally this common switch can create the technical personnel by producing knowledge base on payment systems, finally will create knowledge base for all members bank.

*Governance:* With the recent GTP plan, one of the government’s initiatives is to enhance the financial institutions to reach unbanked societies and creating financial inclusions. Based on this, the proposed common switch will facilitate the payment system by inviting banks who haven’t EFTSwitch for fast implementations and integrations.

*Business:* The business modality proposed is closed national switch, with establishment of a common company to run the business of the EFTSwitch platform. This will solve the business constraints of the limitations associated with both local and foreign outsourcing on open with outsourced Processing. Additionally there is also an

advantage of easy implementation, on top of the gradual learning and skill development is more attainable with the option of establishing a common company on the closed national switch business modality.

### 4.3 Response to different platforms

The proposed platform can work for interoperability in different platforms that will work to avoid the duplication of resource and knowledge for banks.

*Banks with EFTSwitch:* On the proposed modality banks with EFTSwitch implementations can use the proposal for resource sharing. They can connect with the common switch for interoperability and resource sharing. Also the common switch can be configured for STIP processing for those who have EFTSwitch when there is an issue on their EFTSwitch.

*Banks without EFTSwitch:* The proposed solutions are able to accommodate a direct connectivity for banks without EFTSwitch. In this platform they can use as Third Party Processors (TPP) model to deploy their ATMs and POS terminals if they want to continue in the acquiring models or to accept transactions for issuing model.

## 5. Related Work

### 5.1 The Berlin Group

With the vision of European Central Bank (ECB), the European Commission (EC) and the European Payment Council (EPC) on card payments in a single Euro Payment Area (SEPA), they created The Berlin Group with the participation of 23 major players in the card industry from 10 different Euro-zone countries and from the UK, Sweden, Denmark, Norway, Iceland, Latvia, Estonia, Lithuania, Turkey, Croatia, Bulgaria, Hungary and Serbia aimed on capitalizing and preserving the high levels of efficiency, brand awareness, security, convenience and ease of use in national card schemes [5].

The group has explored the feasibility of this concept with compatible card schemes within the Euro-zone and has defined a common set of standards for interoperability between the acquirer host and the issuer host, which is independent from a specific card scheme. The principal goal is to meet

the aims of the EPC, the ECB and the European Commission with regard to a Single Payment Area, and in particular to be compliant with the SEPA Cards Framework which has been developed by the EPC.

The Berlin group concentrated on the technical interoperability than discussing on Organizational or Semantic Interoperability. It requires crafting a framework on Organizational and Semantic interoperability before using the technicality in the case of Ethiopian scenario, hence adapting the Berlin group approach to our own use may lack the wholeness of the issue raised on the problem analysis.

### 5.2 The Euro Alliance of Payment Schemes (EAPS)

The Euro Alliance of Payment Schemes (EAPS) is a joint initiative by European payment schemes, enabling European cardholders and retailers to make card payments and cash withdrawals with payment card across Europe's national boundaries. The objective of the EAPS is to enable participating schemes to offer their member banks with a new alternative for pan-European card payments [6].

The EAPS believes that the implementation of the open Berlin Group Standards enhances competition and strengthens European presence and influence in the card payment market. The objective of EAPS is to deliver facilities along the vision of European banks, card holders, business and regulators for secure, reliable and efficient card payments across Europe. The standardization work of the Berlin Group plays an important role in supporting the efficiency of European card transactions and guarantees independence from proprietary standards.

## 6. Conclusion

Currently Ethiopian banks are willing to invest in a modern payment system to expand the range of services, promote efficiency, and bring down cost. The restricted number of Automatic Teller Machine (ATM) and Point of Sales (POS) terminals in the country should expand using the interoperability mechanism in order to offer their cardholders more convenient and efficient payment services and to

widen their client-base. Within this context, the proposed requirement driven interoperability model will help in using their clients in more efficient ways for the existing transactions and other projected banking services in meeting the demand of the banking sector client-friendly. It is convenient and cost-effective for communication and processing payment, creating large customer base for more efficient payment transactions, development of efficient and low cost channels for payment systems as well as reducing the risks in the infrastructure for payments and clearing and settlement transactions.

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