

# An Analysis of Mobile Payment Platforms

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**Abstract**— with the significant growth in wireless evolution and mobile commerce development, a business will achieve superior performance by using mobile devices as a tool for payment. Since there are several platforms for mobile payment, the problem of platform selection is a challengeable issue. In response to this issue, a comprehensive research should be done on various platforms for implementing mobile payment systems. The purpose of this paper is to review and classifying some of the most popular technologies that have been identified in the literature for the development of mobile payment platform and the advantages and disadvantages of the identified technologies are discussed. We apply MCDM method for assessing and comparing these different platforms, with regard to technical and business aspects. The results lead us to believe that SIM-based application with SMS is the best solution in compare of others.

**Keywords**- *M-commerce, Mobile payment, Mobile service platform, MCDM technique*

## I. INTRODUCTION

Nowadays by passing about half a century from the birth of primitive mobile phone generations, it is almost impossible to imagine life without them. As a result, the usage of mobile services becomes a comprehensive and accessible phenomenon, and mobile operators compete with each other in attracting new subscribers and keep existing ones.

Today there are different mobile services which offered by organizations around the world. The significant growth of these services reveals the importance of mobile payment. Mobile payment refers to any payment which conducts on mobile devices such as mobile phone, PDA and tablet [15].

Designing mobile payment system has become a challengeable issue due to several factors which affect on it. These factors attribute to various fields, such as customer preferences, technological environment, social culture, legal regulatory and standardization. In addition to these factors, mobile payment is a multi stakeholder problem, in which different criteria should be recognized.

The acceptance of mobile payment system mostly depends on the platform which payment relies on. Visa defines mobile payment platform as any comprehensive suite of technology tools, security standard and business models

which enable issuer and mobile operators to develop mobile services [19].

In this study we have focused on implementing mobile payment system in according to applicable platform which can be used. For doing this we have specified the relation between the components which will be needed for any platform. We have also discussed on Transaction flow, security issue and involved roles in any platform. For gaining better results, we have collected the experts' opinions in this area and reflect them in comparison of these platforms by using MCDM method. The evaluation criteria which have considered here are based on two important stakeholders' viewpoints, namely end user and payment service provider. Finally we have achieved a precedence sequence in choosing useful platform with respect to the circumstances.

This paper is organized as follows, in next section we summarize some of researches which have been done in this area. We have characterized different platforms for implementing mobile payment systems in section three. In section four we have determined criteria from two separate viewpoint; end user and payment service provider, by applying multi criteria decision making and ELECTRE method with specified criteria, a comparison between these platforms has been done. In section five it has been prescribed which platform will be suited for any mobile services. Finally in section six we have discussed on our research conclusions and propose future research in this area.

## II. RELATED WORK

Until now there are several studies have been done on mobile payment and related issues. Some of them focus on proposing a layered framework for mobile payment [1,2]. Some of researches have worked on challenges which provider face, like interoperability, security and infrastructure of the mobile payment system [3]. Min et al. [4] discussed on critical factors which effect on usability and satisfaction of the consumers from mobile services. Ondrus et al. [5] propose a multi actor multi-criteria framework to facilitate the assessment of mobile payments for the Swiss public transportation industry. Meng et al. [6] Discussed about security requirements and solution for m-commerce and propose a mobile payment model based on WAP. Liu et al. [7] propose an innovative model for mobile payment which focuses on enhancement of privacy and non-

repudiation. Sarajlic et al. [8] specified the most widespread access channels from mobile network operator view.

### III. MOBILE PAYMENT PLATFORM

In this section eight distinct platforms which can be used in designing mobile payment, have been described. These platforms include SMS, USSD, WAP/GPRS, phone-based application, SIM-based Application, dual chip phone, dual slot phone and SRCN<sup>1</sup>. Based on the communication channel in payment (SMS, USSD and WAP/GPRS), phone and SIM-based solutions can be divided in three platforms.

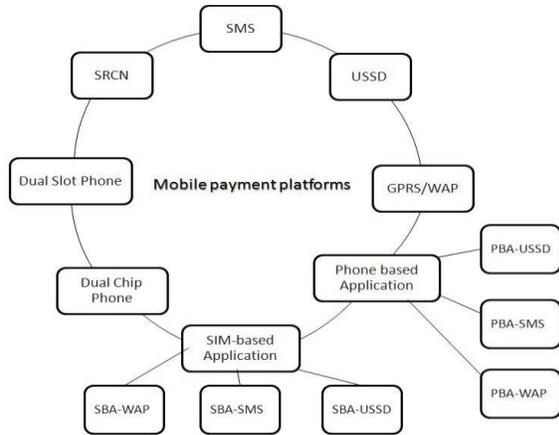


Figure 1. mobile payment platforms

#### A. SMS platform

No special software has been used in this platform. The communication channel between user and payment network is SMS. Here a standard format for sending messages should be used like: timestamp, random number, from account, to account, amount, currency, and target mobile number. The payer authentication is based on payer mobile number and PIN. Because of security problem related to PIN a more safe solution achieved by one time password.

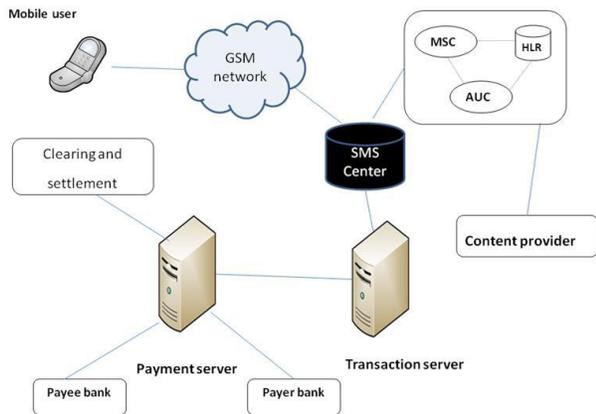


Figure 2. Mobile payment platform based on SMS

#### B. USSD platform

USSD is a capability of GSM network which can be used for transferring information between mobile phone and application. User requests a service by entering short code on mobile. Format of code is standardized and content is specified for each service, the content can be like {USSD code, from account, to account, amount, currency, target mobile number}. USSD gateway service provider communicates with GSM network through SS7 protocol. As Fig.3 shows, user sends his USSD request to USSD gateway. USSD gateway makes a session and route session information to suitable application. The application sends back this information to USSD gateway in XML form. USSD gateway makes USSD message and sends back to user. Bank interaction can be done by payment server with involved banks.

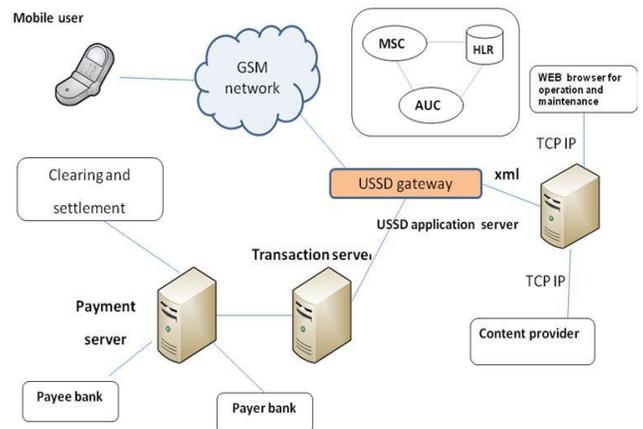


Figure 3. Mobile payment platform based on USSD

#### C. WAP/GPRS platform

In fact this is an alternative for payment through Internet by using mobile phone. Authentication of the payer will be done by digital certificate, mobile phone number and PIN. An URL link in mobile phone download associated certificate. Transferring of information routed by GPRS network and WAP enabled phone. WAP uses a special language WML for communication Between WAP Gateway and content on the Internet. The WAP GW converts between WML and HTML, allowing delivery of WAP based content to a WAP capable mobile device. As shown in Fig.4 user sends the request through GPRS network, WAP gateway routed the request to content server. As in previous section referred, bank operation will be done by payment server and involved banks.

<sup>1</sup> short ranges communication network

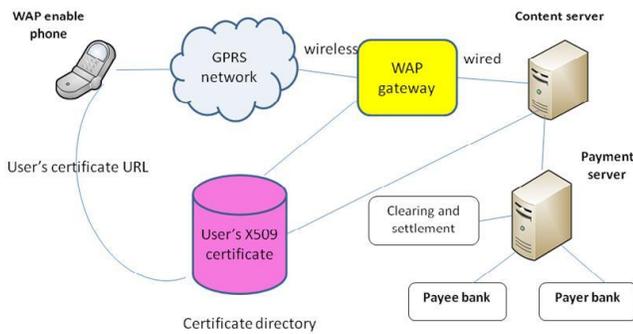


Figure 4. Mobile payment platform based on WAP/GPRS

#### D. Phone-based application platform

In this platform, payment software installed on mobile phone and payment operation will be done through this software. A communication channel (SMS, USSD and WAP) will be needed for transferring payment information onto mobile payment system. According to which channel will be used; cost, security and accessible services will be different. J2ME or BREW is tools for developing payment software according to GSM or CDMA network which used. The disadvantages of this platform include; applicable only on JAVA enabled phone, manual installation and update, twice installation in case of phone exchange, different versions for various phones. Beside these drawbacks, the advantages of using J2ME are end to end security, content encryption and improvement of network bandwidth usage.

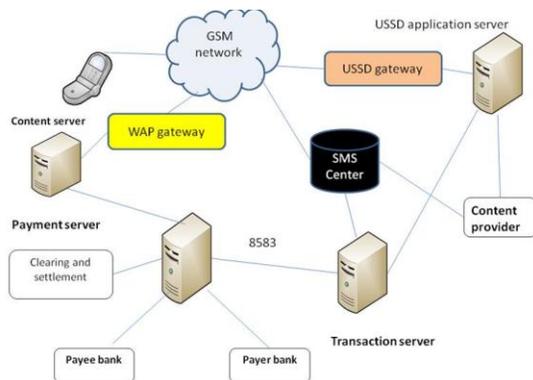


Figure 5. Mobile payment platform based on phone-based application

#### E. SIM-based application platform

This platform is based on application which installed on SIM. User receives payment software and other services directly through OTA server. When the software successfully installed, user can send his request for supported services onto operator. This request process in OTA server and recorded on transaction server. This platform enable user to encrypt his messages, OTA server decrypts the messages by HSM which include encryption keys. Tool for developing application like this is called SAT. SIM-application toolkit enables SIM for value added service. It consists of a set of

instructions which programmed on SIM and specify how to interact with outside of network. A special SIM-card called WIB-card is a very suitable product for mobile operator wishing to deploy a wide variety of values added services and applications. It has many useful features like data security, speed enhancement and anti-conning mechanisms. STK menu with WIB-based programming can be updated speedily through OTA and SMS. A sample of this system was also proposed by[14].

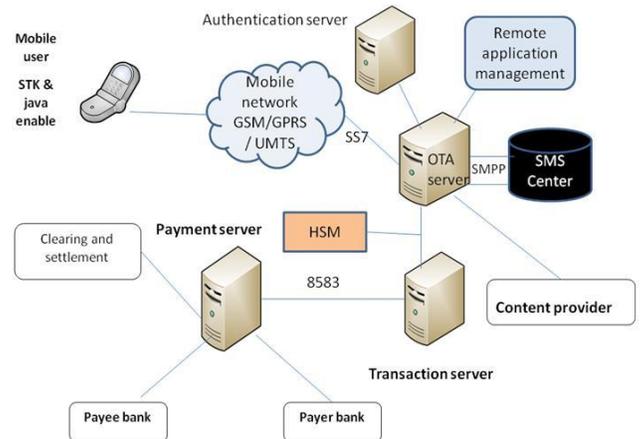


Figure 6. Mobile payment platform based on SIM-based application

#### F. Dual chip phone/ dual slot phone platform

Some of phones have the ability to keep two chips, often one of them is SIM-card and the other one is a payment card which permanently place in the phone. The Personalized information will be provided by the second card. EMPS is a joint product of three companies; visa, Noreda bank and Nokia, in which payment process is in this way [18]. Currently this project is in pilot phase. Some of phones equipped with second slot. In order to initiating a payment, user should place the second card on the phone and start the transaction by entering related PIN number.

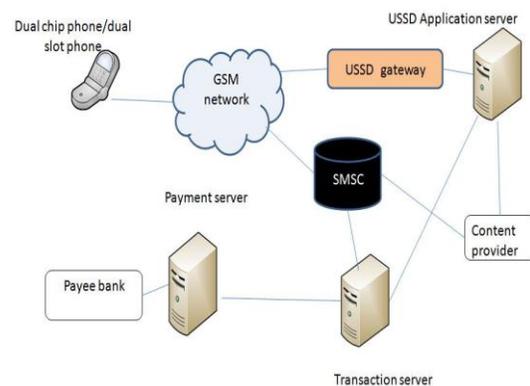


Figure 7. mobile payment platform based on dual chip/ dual slot phone

### G. Short range communication network platform

In this platform purchase information can be sent through short range communication network like Bluetooth, NFC technology and IRDA to the POS or vending machine and the user charges with phone bill. This way of payment is suitable for micro payment and adopted with operator centric business model.

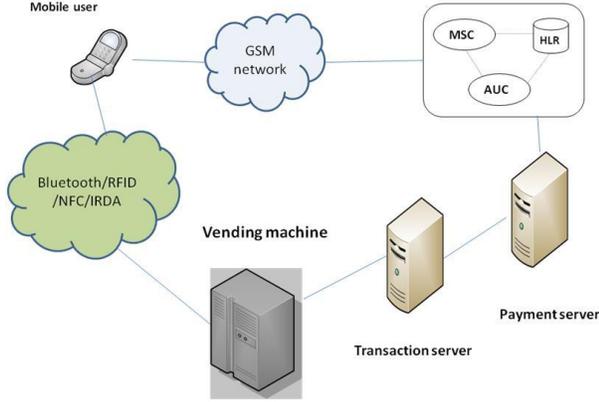


Figure 8. Mobile payment platform based on SRCN

## IV. MCDM MODEL: MOBILE PAYMENT PLATFORM AND EVALUATION CRITERIA

In this section we introduce criteria from two perspectives; end user and payment service provider. By applying MCDM model and ELECTRE method, a comparison between mentioned platforms will be done. MCDM refers to find the best opinion from all of the feasible alternatives in the presence of multiple, usually conflicting, decision criteria [9].

### A. ELECTRE method

In order to better understand how results obtained, we present a brief description of this method before utilizing in gathered data [12].

Assume: A represents a set of feasible alternatives:

$$A = \{A_i | i = 1, 2, \dots, n\}$$

I represents a set of evaluation criteria:

$$I = \{C | j = 1, 2, \dots, m\}$$

Assuming that there are identified weights for evaluation criteria.

$$W = \{W = W_j | j = 1, 2, \dots, m\}$$

The concordance index for two alternatives index h, k is defined as follow:

$$C(h, k) = W^+ / (W^+ + W^= + W^-) \quad \forall h, k; h \neq k$$

Where

$$W^+ = \sum_{j \in i^+} W_j$$

$$W^= = \sum_{j \in i^=} W_j$$

$$W^- = \sum_{j \in i^-} W_j$$

The discordance index for two alternatives h, k is defined as follow:

$$D_j(h, k) = |g_j(A_h) - g_j(A_k) / \max_{j \in i^-} (g_j(A_h), \theta_j)|$$

$$\forall h, k; h \neq k$$

Where  $g_j(A_h)$  is the performance value for alternative Ah in criterion j.  $\theta_j$  refers to the R-degree parameter used by a decision maker for criteria j to represent the degree of attention paid by the decision maker to criteria j. Both index values are then compared with the respective thresholds p, q to determine their significance.

$CON(a, b) > P_c$  a strongly prefer to b

$q_c < CON(a, b) < P_c$  a weakly prefer to b

$CON(a, b) < q_c$  a and b are indifferent

$DIS(a, b) > P_d$  b strongly prefer to a

$q_d < DIS(a, b) < P_d$  b weakly prefer to a

$DIS(a, b) < q_d$  a and b are indifferent

### B. Evaluation criteria

Deciding on which platform will be suitable for designing mobile payment system depends on several factors. These factors may vary or at least they have different importance degree for user and provider. User criteria presented in Table.1. the criteria specified in table.1 also proposed by [5, 16, 17].

TABLE I. USER CRITERIA

Technical acceptability	cost	security	Ease of use
scalability	initialization	privacy	Less operation
Performance	transaction	confidentially	User Preferences
Remote access	membership	integration	Easy downloading and installation
comprehensiveness		Non repudiation	flexibility
		authentication	

TABLE IV. QUESTIONATY RESULTS

criteria	weight	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
C1	4.3	8.38	8.08	8.19	7.96	7.77	7.85	7.73	7.88	7.96	7.4	7.19	7.76
C2	4.67	8.88	9.15	8.88	9.04	8.81	8.92	9.12	9.15	9	8.88	8.92	8.88
C3	4.04	7.88	7.65	7.62	7.73	67.65	7.42	7.92	7.81	7.96	7.6	7.65	7.36
C4	3.11	6.58	6.35	5.65	6.19	5.92	6.32	5.73	5.96	6.27	6	6.16	6.36
C5	4.48	8.73	8.77	8.62	8.31	8.35	8.31	8.85	5.58	8.62	8.65	8.68	8.76
C6	4.15	7.88	7.5	7.62	7.88	7.54	7.62	7.92	7.77	8	7.48	7.2	6.48
C7	2.58	6.38	6	5.36	5.5	6	5.42	5.54	5.46	5.88	5.12	5.24	5.64
C8	3.93	7.77	7.31	7.58	7.54	7.23	7.27	7.46	6.69	7.08	6.4	6.68	6.56
C9	3.48	6.77	6.42	7.46	6.88	7.08	6.95	6.88	6.5	7.08	6.48	6.68	6.16

Criteria from payment service provider viewpoint are as following:

- **Security:** this criterion represents the level of security a provider should consider, security mechanism, encryption algorithm and the implementation issues [16,17].
- **Cost:** can be in form of fixed cost and variable cost related to transaction. This criteria was also proposed by[13].
- **Cultural and customization conditions:** utilizing of which platform will attract more users and will be suited for the country.[ proposed by author]
- **Ease of implementation:** what is the impact of ease of implementation on system design . [ proposed by author]
- **Global standards:** what is the impact of global standards on system implementation [17] ?

C. Data collection and comparison result

For collecting data a questionnaire was prepared and had given to experts in order to declare their opinion about the importance of each criteria and also the supportability of each platform in respect to these criterion.

TABLE II. ALTERNATIVES AND CRITERIA

Alternative		Criteria	
A1	SMS	C1	Ease of use
A2	USSD	C2	Security (end user)
A3	WAP/GPRS	C3	Cost(end user)
A4	phone-based application with SMS	C4	Technical acceptability
A5	phone-based application with USSD	C5	Security (service provider)
A6	phone-based application with WAP/GPRS	C6	Cost (service provider)
A7	SIM-based application with SMS	C7	Cultural and customization condition
A8	SIM-based application with USSD	C8	Ease of implementation
A9	SIM-based application with WAP/GPRS	C9	Global standard
A10	Dual chip phone		
A11	Dual slot phone		
A12	SRCN		

Table 4 shows the result of 27 forms. We have computed the average entries. By applying ELECTRE method on gathered data the concordance and discordance tables have

been obtained. Then we have specified suitable thresholds for concordance and discordance index in order to obtain the priority of the platforms. The comparison results conduce to:

$$A7>A1>A2>A9>A4>A8>A3>A6.A5>A11>A12>A10$$

The results show SIM-based application with SMS channels is the best solution in comparison with others. We should consider that, this research has performed in Iran and these results will be suited well, according to technological conditions and user preferences, which will be different in various places

V. MOBILE SERVICES

In this section we are going to specify the capability of each platform for satisfying any mobile services group. Until now several technical researches have been carried out on mobile services and needed infrastructure [10,11].

Here we focus on the field in which a service can be used and the added value which will be provided for the user. We have defined five distinct services in wireless environment. They are including:

- bill payment
- banking/financial(funds transfer, closing account, account history)
- digital content purchase(game, music, entertainment, top up, news)
- physical good purchase(web store , POS)
- reservation(hotel, restaurant, transport)

The supportability of each platform for any services has shown in table 3.

TABLE III. MOBILE SERVICES AND PLATFORMS

Platform/scenario	BP	BF	ECP	PGP	R
SMS	✓	✓	✓	✓	✓
USSD			✓		✓
GPRS/WAP	✓	✓	✓	✓	✓
Phone –based application	✓	✓	✓	✓	✓
SIM-based application	✓	✓	✓	✓	✓
Dual – slot phone	✓	✓	✓		
Dual chip phone	✓	✓	✓		
SRCN			✓	✓	✓

## I. CONCLUSION

In this paper we specified eight possible platforms for mobile payment. In each platform the architecture, involved roles, transaction flow and security has been determined. By using MCDM method and ELECTRE technique we have compared the platforms in according to evaluation criteria. We have found that the importance degree of each criterion will be different according to involved stakeholder. Hence service providers have to notice the criteria from different perspectives with different priority and considered them in their platforms. The results showed that SIM-based application with SMS communication channel is the best solution with consideration of Iran technology limitation.

For future research we can examine other criteria from different stakeholder viewpoints. Also we can use other techniques in MCDM like AHP, linear programming and etc for comparison of platforms. Needed time for system development and SLA concept in proposing mobile service are remarkable problems for assessment of mobile payment systems. Obviously more general survey need to be conduct on mobile payment platform to operationally test the platform in any situation. However we believe that, this preliminary study will be useful in future researches.

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