Mobile Payments: what we can learn from the past

By

Gladys PRISO

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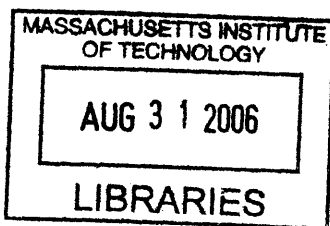## Massachusetts Institute of Technology

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Certified by ⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯
Henry Birdseye Weil
Thesis Supervisor

Accepted by ⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯
Steven J. Sacca
Director, Sloan Fellow Program

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Abstract

Over the last decade, there has been a proliferation of mobile payments systems (MPS). Close to 150 MPS currently exist in the world according to the Bank for International Settlement records (BIS). Mobile payments (MP) markets are at different stages of development depending on countries. However, most of them are going through their embryonic or early phases. According to the theory, at this fluid stage, where no dominant design has emerged, it is nearly impossible to predict industry evolution.

This paper tests the hypothesis that (i) because the MP industry is a path dependent system rather than a hysteresis system whose state depends on their immediate history, (ii) we can actually rely on accumulated experiences (success and failures) to narrow markets options in terms of dominant players and speed of adoption.

In this paper, we elaborate a classification matrix of payment services and using the Weil-Utterback system dynamic model of the diffusion of innovation we analyze the main loops at play in US, Europe and Japan. In the process we provide numerous examples of MPS and several case studies. The key take aways of our analysis are that (i) incumbents are likely to dominate the offering of mobile payments services. (ii) in the next three to five years, US rate of adoption is likely to be faster than the European one.

Thesis Supervisor: Henry Birdseye Weil
                      Senior Lecturer, MIT Sloan School of Management

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1. INTRODUCTION: WHY HISTORY MATTERS

Mobile payments markets are at different stages of development depending on countries (see figure 1) but most of them are at their embryonic or early phases. Using the Utterback framework for technology life cycle summarized in figure 2, these markets are mostly at their fluid stage and few may have started their transitional phase. As a result of the high level of uncertainty in products and markets it is supposed to be nearly impossible to predict industry evolution.

Figure 1: Global ranking of m-commerce/m-payment[1]

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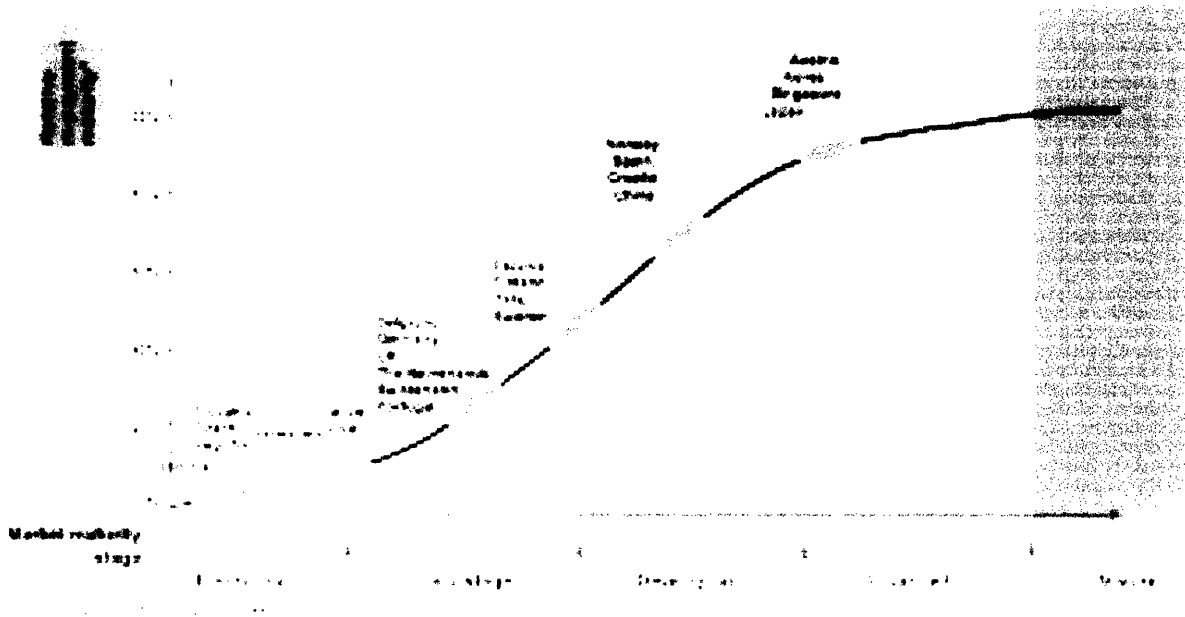
[1] Soure Arthur D Little, December 2005. The ranking is based on several parameters: the breadth of m-commerce services offered, how well the services are integrated among the participants of the value chain and to what extend the market players have solid and clear m-commerce strategies.

However, some system dynamics models provide frameworks to understand the fundamental dynamics of the diffusion of innovations that can be applied to MPS. Furthermore system dynamics reveals that MPS businesses are path dependent. In other words, 'the outcome of the ultimate end state depends on its past history, on the entire sequence of decisions made by agents and resulting outcomes, and not just on contemporary conditions (or immediate history). This principle tells us that "history matters"' [2]. Consequently it is worth reflecting on what we can learn from past and current MPS.

Figure 2: Characteristics of the four technology phases

	Fluid Phase	Transitional Phase	Mature Phase	Discontinuities Phase
Dynamics of the phase	Uncertainty in products and markets High rate of product innovation and high degree of process flexibility Fast-growing demand low total volume Greater importance of product functionality than brand names Little direct competition	Appearance of dominant design Increased clarity about customer needs Increased process innovation Importance of complementary assets Competition based on quality and availability	Strong pressure on profit margin More similarities than differences in final products Convergence of product and process innovations	Invasion of new technologies Increasing obsolescence of incumbents assets Lowered barriers to entry new competition Convergence of some markets as new technologies emerge

Source: MIT Sloan Management Review

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[2] Wikipedia

In chapter three, we begin by introducing the system dynamics model we elected, then in chapter four, we provide a typology of MPS and discuss why they are not systematically disruptive and why their definition tend to be confusing. Chapter five explores the logic behind stakeholders strategic choices. Finally in chapter six, we put our model to work and introduce both a classification matrix of MPS and a system dynamics analysis of US, European and Japanese markets. Chapter six contains both detailed descriptions of various payments schemes and case studies.

While writing this paper, we have faced the following challenges; Firstly, balance the tension between our need of very detailed data on how services actually worked and our goal to come out with a high level view. Secondly, compensate the lack of a comprehensive global updated and public database on MPS (past an current). Often factual descriptions were not enough detailed to know who was doing what there and, as you will see, it is important to know such details. Therefore we have had to spend more time than anticipated gathering and updating primary information.

We have learned a lot during this research, not only about MPS per-se, but also about national differences and competitive dynamics complexities. We do believe that the understanding of core dynamics can help narrow uncertainties of complex systems and hope to be able deepen our understanding of system dynamics in the future.

2. KEY FINDINGS

1. Incumbents (banks, payments networks, credit card issuers and wireless operators) are more likely to dominate mobile-payment markets because of the following characteristics.

   - They operate 'bottleneck facilities' (payments systems and payments networks) and they can have a monopolistic behavior, excluding new entrants from their 'natural territory': In other words, even if incumbents monopolist footprint are not large enough to force their rivals to stay out of the market completely, exclusion from part of the market may put potential rival at a severe competitive disadvantage by forcing them to operate at a less efficient scale or with a smaller network.

   - Incumbents can leverage their vast customer bases and benefit from network effect even without pre-existing market standard.

   - Customer satisfaction with current payment methods creates barriers to the adoption of new payment schemes. High-profile Internet payment failures such as those of CyberCash, DigiCash, Digital Equipment's Millicent, Flooz and Beenz made financial giants such as VISA, MasterCard and CitiBank reconsider mass-marketing any product they had successfully pilot tested. These failures should make us cautious about taking demand behavior for granted. Subsequently, MPS value proposal must be strong on the usage, while new entrant payment systems have generally not provided a strong enough collection of value propositions such as, for example,

security, user convenience, user value, or merchant support to prove worthy substitutes for existing bank-operated systems.

2. The US mobile payment ecosystem is likely to structure around financial institutions (payment networks and banks) allied with handset manufacturers. In Japan, but also in Europe network operators are driving markets growth, allied with a new breed of banks or 'near banks'.

3. In Japan, but more surprisingly in the US conditions for the emergence of an uncoordinated standard exist. What is not the case in Europe, as a whole.

3. A SYSTEM DYNAMICS MODEL TO CAPTURE THE DYNAMICS OF MOBILE PAYMENTS MARKETS

Literatures in technology diffusion characterize dominance as the key event in the evolution of a technological innovation. However, the emergence of dominance has been typically viewed as a black box process involving sophisticated interaction of technological and non-technological factors. From microeconomic perspective, diffusion is at the core of the process of evolving. The strength and speed of diffusion influence the emergence of dominance among competing technologies. Consequently, we selectively reviewed the most popular models of innovation diffusion looking for the model that captured the best the dynamics at play within the 'black box' and selected the Weil-Utterback model (2005) introduced in 'the dynamics of innovative industries.' Indeed, the logistic model, and similar simple growth models, is widely used to explain the diffusion of innovation and many other phenomena. However regarding MP, the model is not detailed enough to allow us to understand the dynamics at play. Building on the logistic model, the Bass diffusion model (1969) is more complete and notably addresses the start-up problem. However, the model is very much product centric while we want to analyze 'system adoption' [3] rather than 'product adoption'.

The Weil-Utterback model captures the fundamental dynamics of technology adoption. Given the goal of our research, we will focus our analysis on the market level.

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[3] As awe are dealing with a two sided service with network externalities

Figure 3: Weil-Utterback model of technology diffusion at the market level
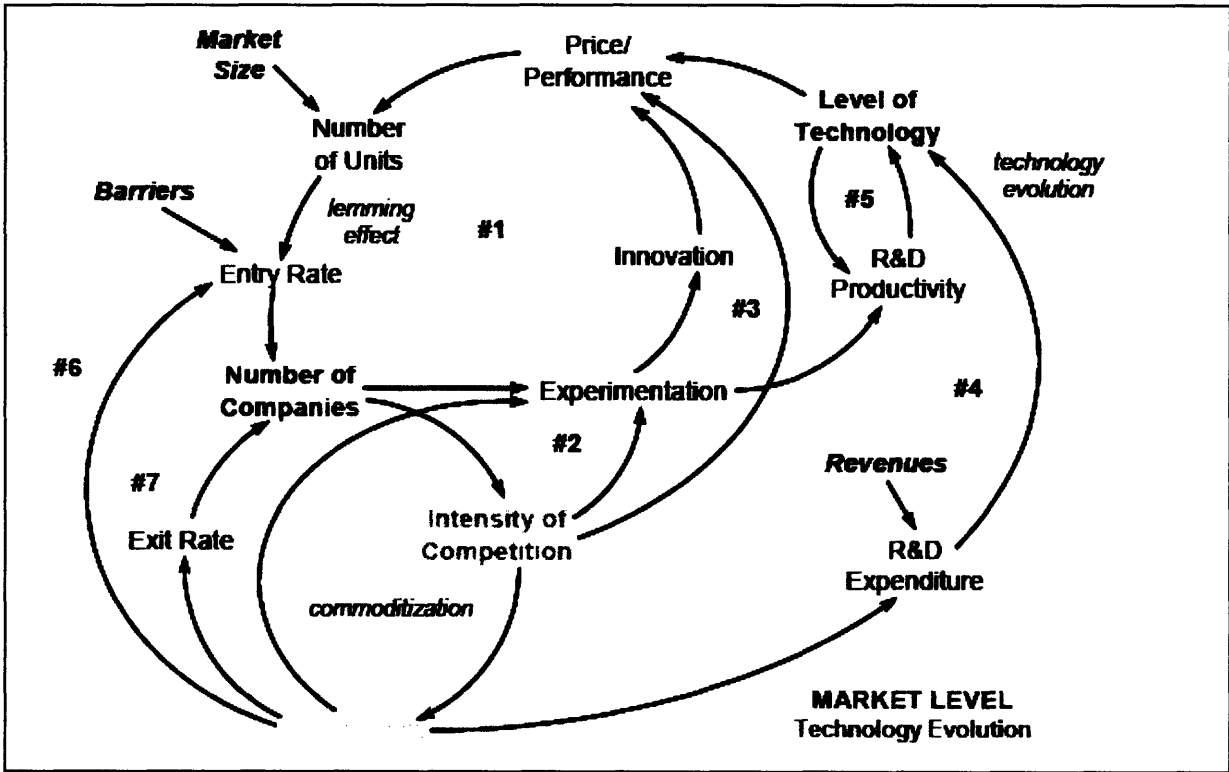
Source: Weil, Turning Innovation Into Value, Phase 1 Report, June 2005

The model presented in figure 3 captures technology life-cycle. The number of companies in the market, the level of technology, the intensity of competition and products profitability are the key variables accounting for the diffusion of innovation. Because we will be dealing with a relatively high number of countries, we choose not to investigate the complete model and to reduce the number of variables we were going to explore to the most relevant to the MP industry. The model also identifies two fundamental dynamics that connects the variables listed above; the number of firms in the market and customer's willingness to adopt. We elected to focus on the latter.

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Figure 4: Weil-Utterback model of technology adoption at the market level
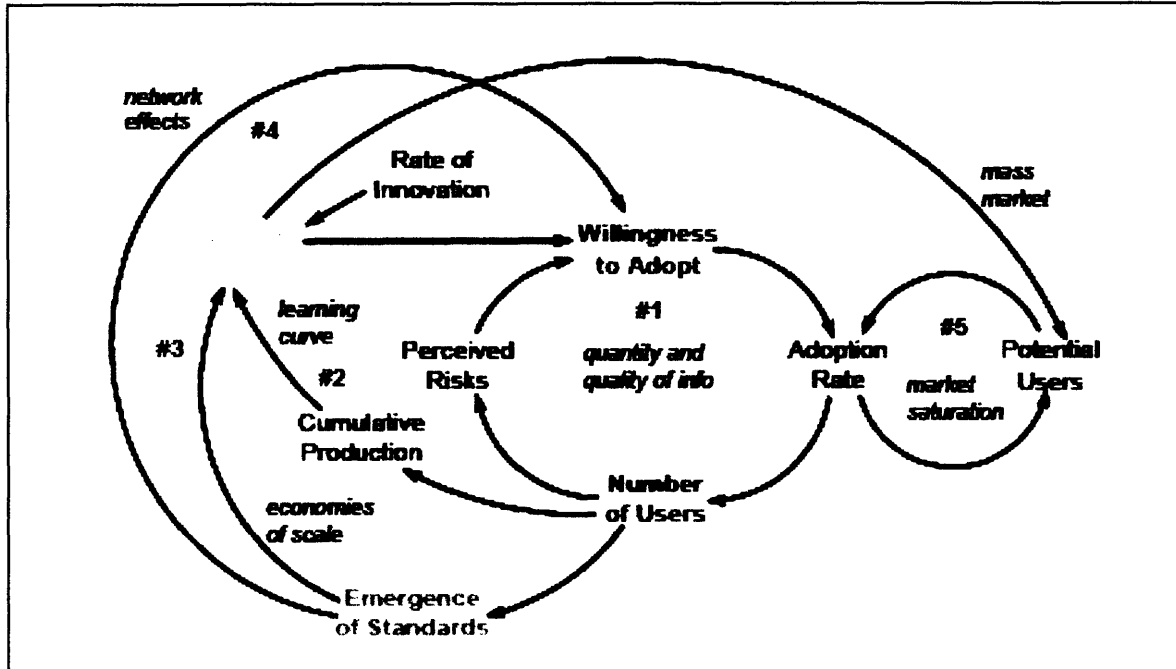
Source: Weil, Turning Innovation Into Value, Phase 1 Report, June 2005

The model in figure 4 has two stocks, the number of potential users and the number of users. The rate of adoption of a new technology is determined both by the number of potential users and their willingness to adopt. Following is a description of the model feedback loops.

- 'Adoption of the new product/service increases the number of users and quantity and quality of information available in the market, and thus reduces the perceived risks of adoption (loop #1);

- 'Unit cost generally declines and quality improves as a function of cumulative production, thus increasing the willingness to adopt the new product/service and the

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number of potential users (loop #2);

- Emergence of the dominant standards and design triggers industry consolidation, leading to a few large suppliers who can realize substantial economies of scale, thus increasing cost/performance and willingness to adopt (loop #3);

- The emergence of standards also enables network effects where the value of the product/service increases non-linearly with the number of users, and thus directly affects willingness to adopt (loop #4)

- Adoption of the new product/service reduces the number of potential users, and thus constrains the future adoption rate (loop #5)"[4].

The Weil-Utterback model clearly exhibits path dependency property for MPS. The model dominant reinforcing feedback mechanisms, like network effect and economies of scale are at the origin of the path-dependence. In our model, the main balancing loop is market saturation. In a path dependent system, 'the eventual end state depends on the starting point and on small unpredictable perturbations early in its history. Even when all paths are equally attractive, the symmetry is broken by microscopic noise and external perturbations. Positive feedback processes then amplify these small initial differences until they reach macroscopic significance. Once a dominant design or standard has emerged, the costs of switching become prohibitive, so the equilibrium is self-enforcing: the system has locked-in.'[5] Our analysis detailed in chapter six will focus on the following loops:

- Emergence of a standard/ and network effect

[4] Henry Birdseye Weil, Turning Innovation Into Value, Phase 1 Report, June 2005
[5] John D, Sterman, Business Dynamics, September 2005

- Quantity and quality of information available and perceived risk

- Economies of scale and Cost/performance

4. WHAT MOBILE PAYMENTS ARE AND WHAT THEY ARE NOT

In order to have a fruitful discussion on m-payments, it is necessary to define the concepts used. All the more, as they are many misunderstanding around the definitions of MP. The aim of this chapter is therefore to walk towards a common understanding of the concepts involved. In this paper, following the definition given by the Mobile Payment Forum, we will define a MP as any payment where a mobile device (PDA, smart phone, converged device) is used in order to 'initiate, activate, and/or confirm the purchase good or service'[6]. Transactions conducted using a laptop are therefore not regarded as a part of MP but rather considered to be a part of Electronic Commerce. The next sections of this chapter are organized as follow; we begin by describing a typical electronic transaction, then we propose a pragmatic typology of MP services. Latter, we explain what makes their definition confusing to raise awareness of some definitional issues and related scope. We conclude by providing the reader with a high level overview of MP services supply chain.

4.1 A TYPICAL ELECTRONIC PAYMENT

An 'electronic payment' or e-payment is the transfer of an electronic means of payment (e.g.. credit card, debit card, wired) from the payer to the payee through the use of an electronic payment instrument/medium (Point Of Sales payment terminal).

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[6] Besides we will focus on B2C solutions

An e-payment system enables the settlement of a transaction. The financial flow of a typical e-payment that would also apply for most m-payment is depicted in Figure 5. The customer is the party making the payment (Payer); the merchant is the party accepting the payment (Payee); the acquirer is the third party that has a relationship with the merchant (usually the merchant Bank); and the issuer is a third party that has a relationship with the customer (usually the client Bank). A typical procedure followed by credit card companies is as follows. The customer "pays" a merchant for goods/services. Subsequently, the merchant sends the transaction details to the acquirer for clearing. The acquirer sends the transaction details to the financial network to which it belongs (e.g. VISA) which then forwards the details to the issuer. The issuer is informed to make the necessary fund reservation at the customer side.

Figure 5: Flow of a payment in card network
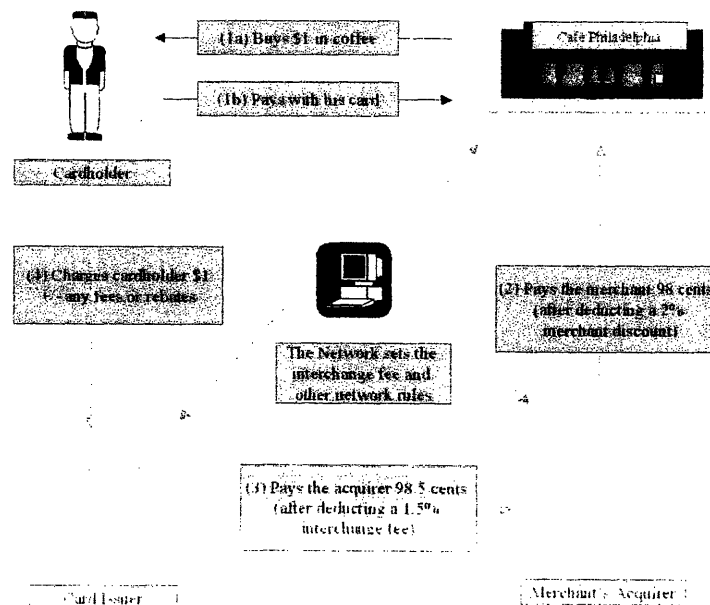
Source: Robert Hunt, Economics of payment cards networks, Federal Reserve of Philadelphia, Press, 2005

4.2 INTRODUCING A PRAGMATIC TYPOLOGY OF MOBILE PAYMENTS

There are currently many MPS. IEEE lists about 120 services. However, this diversity relies on a very limited set of payment instruments, similarly to the way the biological diversity of our world derives from the combination of only four basic proteins.

To come out with the typology presented in figure 6, we started from the common understanding of MPS and walked our way backward to identify underlying payment instruments. It turned out that all MP services MP schemes are based on existing payment instruments.

Figure 6: Typology of mobile payments

Function: The handset is a ...	Definition	Examples of application
Channel to process electronic payments	The handset is used as a channel to process standard electronic payments. Also called mobile accessed payments.	WO (wireless order) Voice based Top Up
Electronic wallet	A stored-value card (SVC) 'represents money on deposit with the issuer and is similar to a debit card. SVC are usually anonymous. The value associated with the card can be accessed using a magnetic stripe embedded in the card on which the card number is encoded; using radio-frequency identification (RFID); or by entering PIN number'[7].	Contactless micro-payments
Credit or debit Card	The handset replaces the small plastic card (virtual POS) through an application embedded in the operator SIM, a third party WIM or in the memory of the handset.	Pin based top-up prepaid account
Point of sale Terminal	A mobile phone based POS terminal with a slot to read credit/debit card is used in place of the terminal for retail/good and service transaction settlement	Machine to Machine transaction at the physical POS

Debit and credit card introduced a new payment instrument (an electronic fund transfer other than wire fund transfer) respect to cash or check. Whereas MP are leveraging existing technologies (wireless, contactless etc) to provide ways for people to interact with electronic fund transfer networks. Even if we consider the radical type of MP, the one where handset replaces the credit or debit card, the handset is still merely the host for a credit/debit card transaction.

4.3 MOBILE PAYMENTS ARE NOT DISRUPTIVE PER SE

MPS are often described as being 'disruptive' according to Christensen innovation theory (1997) introduced in 'The Innovator's Dilemma'. If the case were correct, we should consider that the industry possesses hysteresis property. Consequently, the end state of the system would be determined not necessarily by its history but mainly by its immediate history.

Clay Christensen defines a disruptive technology as something that always meets the following criteria:

1. It always has lower cost than incumbent technology,

2. It always has lower traditional performance compared to the incumbent,

3. It always has higher ancillary performance compared to the incumbent technology.

As demonstrated by a work done at MIT[8] in 2005, micro-payments, which today are the dominant form of mobile of MPS fail to meet the criteria assigned to disruptive

technologies. Although micro-payments meet the first criteria by enabling lower cost of transaction than incumbent technology, they fail the two other. If we assume for simplicity that payment performance is judged as an equally weighted combination of transaction security and speed. MPS have long been known to exhibit a tradeoff between speed and security. Currently, exquisite cryptography must be employed that has a negative effect of processing speed. Conversely, speed is increased when anonymity (and therefore security) is less protected. For MPS, this tradeoff between security and speed creates a zero-sum game that results in lower relative performance than standard credit cards. Thus MPS do not meet the second criterion of a Christensen disruptor. Finally, the benefit that MPS provide is twofold: they lower the hurdle level for card purchases by decreasing individual transaction cost. Depending on the frame of reference used, this advantage could be viewed as either sustaining or ancillary to the standard credit card business model. We conjecture that the MP advantage is in line with more traditional payment methods' value streams, and is thus sustaining. The research concludes that micropayments are rather sustaining to the traditional credit card market: "Sustaining technologies are technologies that improve the performance of established products along dimensions of performance that mainstream customers in major markets have historically valued."[9]

As far as macro-payments are concerned, the typology introduced in the previous chapter reveals that MPS are not systematically a new paradigm of customer offering. In most cases, MPS are leveraging existing technologies (wireless, contactless …) to access and use existing payment instrument. However disruption is only meaningful when

disruptive relative to an existing business model. Therefore there could be occasion for MPS disruption. For instance by targeting people with no bank account in developed or developing worlds, with prepaid solution, MPS would offer cheaper and simpler use of an existing product (electronic fund transfer) to entirely new customers, thus meeting the disruptor criteria. We do not mean to say that MPS are never disruptive. Instead, we would like to counterbalance the popular idea that MP solutions are systematically disruptive.

4.4 WHAT MAKES MOBILE PAYMENTS SO CONFUSING?

Three main factors contribute to create confusion around MPS. At this early stage of development, there is a wealth of different approaches (i) at the level of device as evidenced by figure 7 (ii) at the level of payment instruments supported - credit cards, debit cards, direct debits, prepaid accounts and prepaid cards - see figure 6 (iii) and at the level of supply chains design to deliver services (parties involved, branding, division of role etc.). As a result, suppliers can legitimately claim designing new payment systems while end-user experiences may not be very differentiated. What creates confusion.

Figure 7: The six ways to enable mobile payments using a mobile handset

Type	Underlying technology	Description
Software based	Payment software	The functionalities of the WIM (Wireless Identification Module) would be inside the phone memory
	Camera-enabled phone	A camera-enabled phone captures the payments data from the merchant's terminal screen and proceeds with the transaction
Hardware based	Dual SIM Phone	Both the SIM (Single Identification Module). And WIM have their own slot inside the mobile
	External WIM card reader	An external card reader can be connected to the handset
	Dual slot phone	The mobile phone has a built-in smart card reader. Consumers insert their existing credit or debit cards into the phone
	Multi-application chip card	SIM and WIM combined in a single chip card

Furthermore, a payment has multiple dimensions and a MP even more (see figure 8). Consequently, there is a variety of ways to categorize MPS.

Figure 8: The various dimensions of a mobile payment

Payment instrument substituted		
Cash		
Credit card		
Debit card		
Stored value account		
Tokens/cash surrogate		
Size	**Charging method**	**Place of purchase**
Micro payments (<$2)	Prepaid	Proximity (F2F)
Macro payments (> $20)	Direct paid	Remote
Mini payments ($2 to $20)	Postpaid	-
Seller/Buyer Origin	**Location of Payer's Account Details**	**Transaction risk bearer (Issue payment authorization)**
B2B	Network (server-based)	Financial institution
B2C	Device (client-based)	Payment network
P2P	Chip (client-based)	Other
Validation of exchange	**Communication**	**Type of transaction**
Online	IrFM	Pay Per View
Offline	RFID	Pay Per Unit
-	Barcode	-
Type of purchase	**Clearing/settlement method**	**Geography**
Physical goods	Bilateral	Domestic
Digital goods	Multilateral	Cross-border
Rights (rich media)	Using intermediaries	Single/multiple currency

Expanded from Ondrus' table in M-Business and M-payment, Jan Ondrus, HEC Switzerland, September 2004

Finally, MPS are often confounded with electronic commerce (e-commerce) or mobile commerce (m-commerce). E-commerce and m-commerce are two broader categories. E-commerce primarily consists of the 'distributing, buying, selling, marketing, and servicing of products or services over electronic systems such as the Internet and other computer networks'[10]. M-commerce enables people to buy goods and services using their phones. MP is one of the prominent applications of mobile commerce (other applications are Mobile Banking, Mobile Content, Mobile Entertainment, Mobile Marketing and Mobile Ticketing). M-commerce shares a large subset with e-commerce but cannot be limited to a porting of e-commerce on a mobile device because some applications are specific to handheld devices.

- Proximity payments

- Handset used as substitute of Point Of sales payment terminal

4.5 WRAP-UP: HOURGLASS METAPHOR

Figure 9 provides a useful metaphor to understand the separation of functions within the MP supply chain. At the top of the figure there is a wide range of transaction applications (m-banking, m-payments etc). At the bottom there is a wide range of technologies (wide area and local area communications, etc.). The payment network illustrated at the narrow point of the figure specifies a set of basic communication services involving transactions. Payments networks are communications facilities designed to connect the payee and payer banks together so that they can exchange transaction information. They are a core

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element of the financial infrastructure at the national as well as the international level. These payments networks are not specific to any device or technology. On top of that layer are the channels through which the payment instruction is entered into the payment system. The high level services shown at the top have to be implemented using the various network technologies at the bottom. However due to payment networks, the details and specifications of each part are hidden from other and each can evolve independently.

Figure 9: The hourglass metaphor
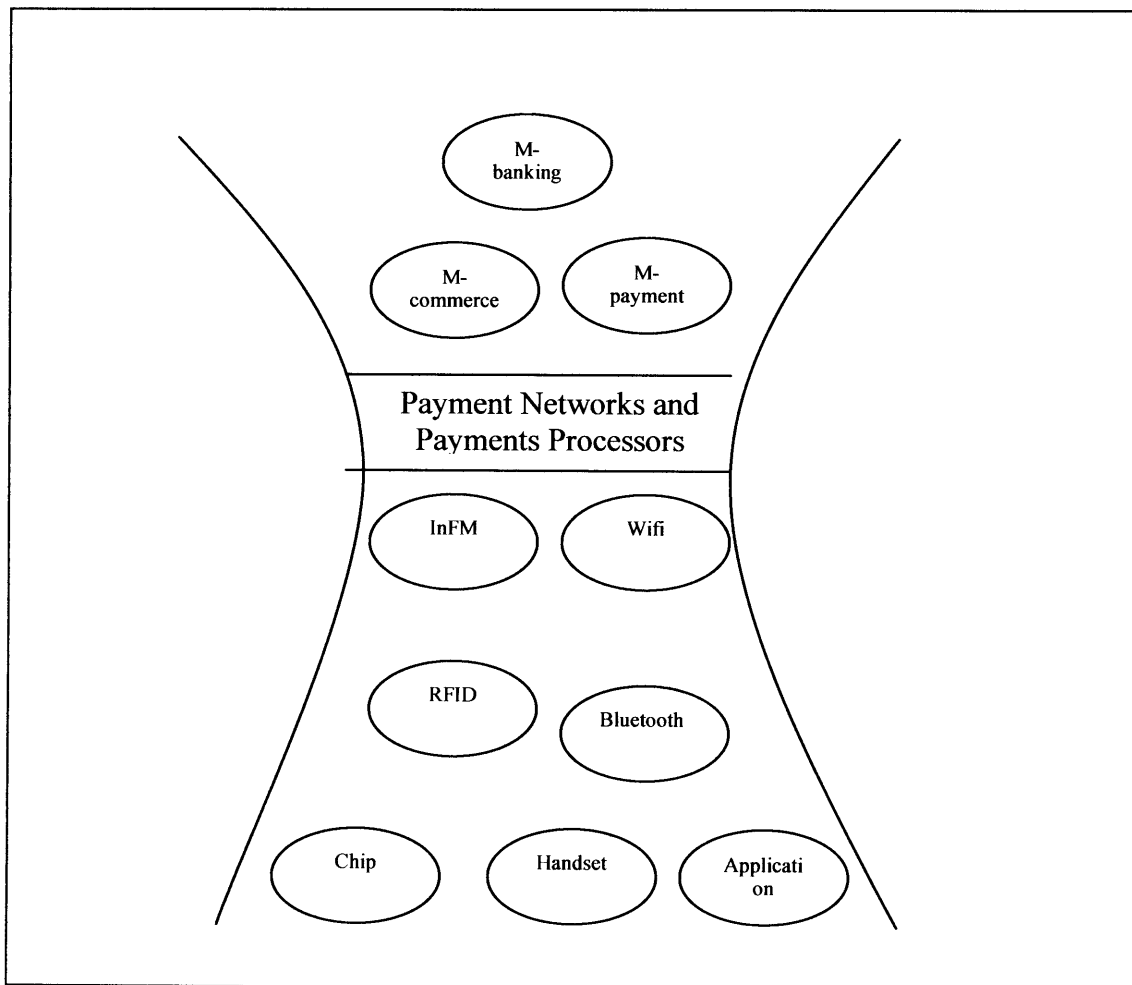
Payments systems depend on a layered architecture (like that of the Internet). Access networks, openness and modularity enable to uncouple particular services from the physical network over which they have traditionally been provided. As a result of that layered architecture, the usage of Bluetooth, RFID, or dual chips phone, on the one hand or the creation of a new payment scheme like P2P on the other hand do not automatically modify established standard transaction procedures. For instance PayPal did not create a new payment network, but alternative paths to connect to existing payments processors. Thus, the power of incumbents payment networks and payments processors should not be underestimated. Depending on the country, payments processors operate under the control of the acquirer bank or the merchant.

5. THE LOGIC BEHIND STAKEHOLDERS STRATEGIC CHOICES

In the second chapter we introduced the system dynamics model we are going to use. In the third chapter, we defined the concepts behind MPS. In this chapter we will explore the incentives and challenges of the main players of the MP arena. This analysis is important for the following reason. At the macro level, the three main forces affecting the diffusion of new payment mechanisms are innovations, incentives and regulation[11]. Advances in technologies and decreasing cost of existing technologies have resulted in the numerous new payment methods already mentioned. However, many have not yet been widely adopted because the various stakeholders have no incentives to modify their behavior. Also existing regulations set barriers that inhibit the widespread adoption of new payment mechanisms. While innovations and regulations are out of the scope of this paper, their influence on stakeholders behavior cannot be ignored. Consequently, we have tried to structure the previous chapter so as to provide sufficient insight on the technologies involved and their future impact. Regarding legislation, we have had to consider regulatory frameworks in our analysis (chapter six) although not explicitly discussed in this paper. This chapter addresses the last factor, stakeholders' incentives and will provide the background for the discussion of markets dynamics in our final chapter. We put the emphasis on the challenges stakeholders face because players strategic choices result from the answer they provide to issues they are facing.

The mobile payment arena comprises the customer (payer) and the merchant (payee). These transact with each other via the MP process whose main players also include the

mobile network operators, the financial sector institutions (banks, credit card companies, payment processors), the government (legislation and regulation constraints), and, of course, the device, software, and service providers. We will narrow our focus on the main parties involved in the mobile payment scheme: Operators, Financial Institutions and Start-ups.

5.1 OPERATORS

5.1.1 Assets

Voice Average Revenue Per User (ARPU) is expected to continue its gradual decline over the medium term. This is for several reasons. Regulation in certain countries has imposed pressures on tariffs, most notably where there is a dominant operator in the market, and has been especially evident for inter-network calls. In addition, increased competition from virtual network operators has led to more aggressive price-cutting. To balance this ARPU reduction and fund license costs operators are looking for developing profitable value-added mobile services. Data services are where operators see significant revenue opportunity in the future.

Analysts usually agree that operators run the risk of becoming closer and closer to pure carriers, and hence, being constrained to simply provide voice and data access over their networks. While it is almost certain that no operator will be restricted to such a role, it is possible that many could be pushed further down the value chain than they would like. This is why it is so important for operators to be involved in the development of new value-added services at a very early stage, especially those services that are closest to their core competencies. Hence many operators have been actively involved for some

time in the development of emergent services such as interactive gaming, location-sensitive applications, multimedia messaging and MP.

Operators have unique assets and capabilities to facilitate MP (relative to other stakeholders). The most apparent strength that operators possess is the knowledge of wireless technology, and an understanding of its capabilities and limitations. However, this core strength does not assist them specifically in the area of MP since other players also broadly understand wireless technology.

The primary strength that operators possess is the ability to process high volumes of small-scale transactions (or micro-payments) in real time, since this is effectively the operation they carry out for they existing billing functions. Operators are able to bill for voice telephony by the second, for amounts as small as $0.01, and aggregate these charges to their customer bill (or debit from a prepaid account). In addition, many operators are able to bill their customers on behalf of third party content providers (such as ring tone, logo and portal information supplier), with the operator taking a commission fee accordingly. It is clear that operators can therefore extend their existing billing systems and infrastructure to facilitate micro-payments for real world goods. Consumers understand their billing relationship with the mobile operator, and in that respect it could be considered straightforward to extend this beyond existing basic mobile-specific services.

One asset that operators can use to their advantage is a large existing customer base. Relative to banks or payment start-ups, for example, operators have a significantly greater number of customers. Vodafone, the largest mobile operator worldwide, has over 170 million proportionate subscribers worldwide. Even in domestic markets, many mobile operators have customer bases that far exceed those of even the largest banks. This is clearly due to the fact that there are far fewer operators than retail banks in every market. To an extent, operators also have certain brand equity that would assist them with regard to marketing power and even control of the customer relationship.

5.1.2 Challenges

The feasibility of operators entering the market for higher value (and more lucrative) payments is weakened by the fact that they do not have any experience in offering large-scale credit to their customers. For many operators, the preferred solution for mobile payments is for their customers to establish prepaid deposit accounts, thereby eliminating credit risk management. Perhaps most importantly, most prepay customers will not want to have to set up large prepay accounts if there is an alternative payment procedure that involves direct access to their existing bank or credit card account. Therefore, the high degree of customer satisfaction traditional payment method such as credit and debit cards may prove a major hurdle to macro m-payments.

Furthermore, operators require additional payment expertise such as risk management and fraud analysis, in addition to establishing new processes to deal with non-payment and repudiation. Besides the operator brand is deficient in perceived security of transactions. While consumers may not be as concerned about the security of micro-

payments, when medium and large scale payments are addressed, it is widely believed that consumers would much rather deal with their existing bank or credit card account.

Operators are still some way of having a detailed understanding of their customers' interests, requirements and preferences. This is especially the case in retail environments where, for example, knowledge of consumer spending patterns will be important in both the design and marketing of payment applications. In addition, operators have still not demonstrated proven competency in the marketing of value-added services, and consumer uptake of services beyond SMS is still remarkably flat.

5.2 FINANCIAL SERVICE PROVIDERS

5.2.1 Assets

Banks, payment networks and credit card associations (hereafter referred as 'banks') have long been the dominant stakeholders in payment facilitation and have managed to retain their position in spite of a number of new payment solutions trying to break into the market. This has largely been due to the fact that new entrant payment systems have generally not provided a strong enough collection of value propositions such as, for example, security, user convenience, user value, or merchant support to prove worthy substitutes for existing bank-operated systems.

Banks have a unique set of characteristics that in certain respects places them most

favorably with regard to controlling MP, and for that reason mobile payments can also be regarded as the most significant opportunity the banks' payment business has ever been presented with. The most significant strength that the banks possess with regard to controlling mobile payments is their experience in facilitating existing forms of payment. Banks have experience in handling large payment volumes. Although this capability to control macro-payments may not be so significant for mobile payments in the short term (since MP are currently dominated by micro-payments), once MP have become more established, macro-payments offer the potential for the greatest source of revenue. In addition, banks have capabilities in credit risk management, and have well-established processes to deal with non-payment and repudiation.

Another asset the banks and credit card associations possess is a strong consumer brand. Consumers have a long history of trusted relationships with their banks. Indeed in the UK the rate of divorce is higher than the equivalent banking churn rate. Consumers understand their bank to be capable to handling transactions securely, and able to manage associated risk in a way that protects the consumer.

Leading credit card associations such as MasterCard, Visa, American Express and Diners have brands that are recognized worldwide. They also have very large existing merchant customer bases. This puts them in an extremely powerful position with regard to encouraging consumer adoption of MP. In particular, the trust and global reach of the credit card brands places them at a significant advantage to other stakeholders in terms of winning consumer and merchant support on an international scale. Consumers should be content using an operator managed payment system for micropayments, since the risk is

so small. However, it is believed that for larger transaction values consumers would generally prefer to have some form of bank or credit card association involvement in a mobile payment solution. For these reasons, it is expected that most merchants would also rather the banks and credit card associations were involved in the provision of a mobile payment solution.

5.2.2 Challenges

Both banks and credit cards have limited understanding of wireless technology and how it would integrate with their existing payment systems. To enter the MP market it is imperative that they develop some form of wireless capability. To address this they would therefore generally be required to partner with a network operator. However, there is a traditional unwillingness to do so out of fear of losing control of the payment business they have dominated for so long. In relation to this, there is a traditional unwillingness to cooperate amongst each other with regard to the development and introduction of new technology.

Furthermore, traditional payment processors only have a limited ability to process micro-payments efficiently. Banks are focused on high value transactions for which they can use their credit and fraud management capabilities. Banks and credit card associations typically apply a minimum transaction charge that results in merchants applying a related minimum purchase amount when making a card payment, for example. This prohibits existing payment processors from entering the micropayments market. However this barrier is disappearing. Indeed, in December 2005, MasterCard has announced his

supports of Peppercoin to aggregate small and micropayments. Peppercoin aggregates small payments so the transaction fees paid by merchants on batches of purchases are less than the cost and aggravation of processing individual payments. Prior to that, in February 2005, Ingenico, the world-leading manufacturer of Point Of Sales Terminals had announced their support of Peppercoin suite.

Finally many financial service have traditionally been slow to adopt new technology, as has been witnessed with the time to introduction of full-range Internet payment solutions and related payment services. Banks are wary of risky investment, and frequently adopt a passive, observational approach to new technology. They often therefore wait for the return on investment models to become fully explored before justifying an investment in new retail initiatives involving new technology.

5.3 PAYMENT START-UPS

5.3.1 Assets

Payment start-ups are mainly a European and American phenomenon and they are competing for the global market of cash transactions that according to Visa is worth over $2 trillion annually.

To some degree payment start-ups are freer to innovate and experiment with new services. Correspondingly, their services are usually more innovative, than those of incumbents. They are not constrained by lengthy planning procedures and related business processes that are usually present in larger organizations. They are also free to

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target niche sectors such as parking applications, before expanding their solution to include additional payment scenarios. They can also respond quickly to feedback from pilot trials and user surveys so that payment systems can be adapted to suit customer requirements and preferences. In this respect they are able to react to emerging market conditions faster, which help in the early stages of rollout. This attribute helps to position their products favorably against those of operators or banks, who may be restrained by the need to establish commercial models and alliance relationships before the design of the payment solution itself. Payment start-ups are also able to adopt new technology faster than larger companies, which have far more complex and time consuming internal budget management processes. Due to systems being designed to specifically address each payment scenario, payment start-ups are able to handle micro-payments in addition to larger value purchases.

5.3.2 Challenges

New payment start-ups face significant challenges that are often overlooked. First, their low brand awareness is a major hurdle to achieve the most important criteria for their success; the rapid acquisition of both merchants and consumers. Yet without a recognized brand, this is an extremely difficult task, which requires large resources. Correspondingly, many payment start-ups are restricted either in their geography, by limiting their solution to a particular metropolitan area, or by in the reach of their payment solution, by focusing on parking scenarios, for example. Additionally, due to low brand awareness, payment start-ups have low bargaining power with merchants. As a result, they are often only able to charge relatively low transaction fees what makes it

difficult to come out with self-sustaining business models. Payment start-ups are also inhibited by the fact that they have zero or low customer bases, which results in a limited capability to conduct efficient market research or trial. This places them at a disadvantage to operators and financial service providers in that they do not have a base of customers to which they can directly market their services through existing channels. In addition, customer acquisition costs are high.

The second main challenge of payment start-ups is that due to the importance of currency control on the economy, payment systems are one of the most heavily regulated businesses in the world. As a Visa white paper states it 'Payments are the lifeblood of economies.' As a result, payments systems start-ups evoluate within a rigid legislative framework that can limit their ability to create a self-sustaining business. We will explore the matter further later, however, we want to illustrate our argument here with the PayPal example.

"Under current U.S. law, stored-value cards, smart cards, and e-wallets are being viewed as liabilities but not deposits, thus allowing non-banks to issue these instruments. This is very important point. The decision to classify these items as "liabilities" rather than "deposits" makes it possible for non-banks to issue the corresponding payment products'[12]. Consequently, in theory, they are considered financial intermediaries, moving data. However, in reality, the situation is much more complex (see Appendix 1). For instance, after years of assertion that their business model fell outside of regulation applicable to banks and money transmitters, PayPal was forced to revise its business model to avoid charges of deposit taking and to obtain licenses as a "money transmitter"

in a large number of states. It was embarrassing for PayPal, since it all came to a head when they were about to do an IPO. To avoid unlawful deposit taking, start-up payment companies need to find a bank comfortable with holding any funds received from consumers prior to the use of these funds to settle a payment transaction. Whether a bank will be comfortable doing so will depend on its comfort with the start-up compliance with the other regulation they must contend with, the money transmitter laws (see Appendix 1).

6. PUTTING THE MODEL TO WORK

To determine what we could learn from past and current MPS, we used the following methodology. To begin with, we created a matrix to classify MPS in a way that allows us to understand both the type of service we are dealing with and the leading participant who is pushing the solution to the market. Then we reviewed available historical data on MPS services for about 97 countries and selected six countries mostly from markets with embryonic or early MPS. Finally we applied the Weil-Utterback model described in chapter three to come out with an overview of markets dynamics. In addition to the data on MPS, we also reviewed regulations, and ownership structures. For sake of briefly, these last two factors are only referred to when relevant.

6.1 A CLASSIFICATION MATRIX OF MOBILE PAYMENT SCHEMES

We designed a 4x3 matrix to classify payment systems[13]. This matrix allows us to (i) structure the complexity of MPS described in the fourth chapter of this paper (ii) present the payments scheme at play in each market in a reader-friendly way (iii) allow comparison across nations based on MPS fundamental characteristics.

The matrix presented in figure 10, has twelve cells. The first axe of our matrix represents the most obvious providers of MPS, wireless network operators, financial institutions (banks, credit card issuers, payment networks) and newcomers.

Figure 10: A classification matrix

Security				
Channel	Card based	Software-based	Phone-Based	+
I	IV	VII	X	Operator Driven
II	V	VIII	XI	Banks Driven
III	VI	IX	XII	Newcomers Driven

Incumbents

Legend
✕: symbol indicates that the related service was discontinued
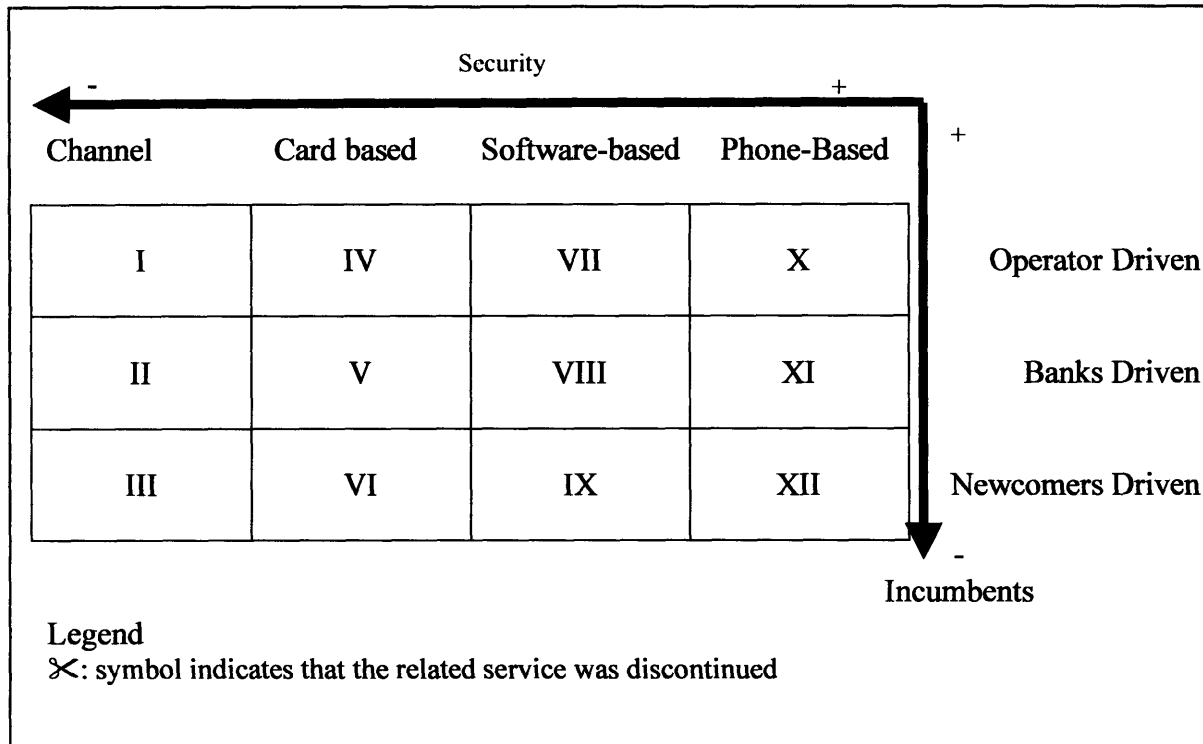
The first row represents the solutions driven by network operators. The middle row corresponds to payments systems driven by banks and payment networks. At the bottom row, are solutions initiated by new entrants (some of which can have a bank license as we will see). The initiator of a MPS is not necessarily its ultimate driving force[14] and players can choose to collaborate, cooperate, or compete. The matrix does not try to capture revenue sharing policies.

The second axis of our matrix is the type of technology used. The first column on the left identifies payment schemes that are only mobile accessed (e.g., the handset is used as a channel to transmit information necessary to process a transaction). The second column stands for solutions that require the physical support of a card. These services are

typically dual chips based and require a modification of the SIM or the presence of a WIM. The payment application is therefore embedded in a phone but could be embedded in any other device without altering the payment scheme. The third row represents solutions that only require a specific software (downloaded in the phone memory or in the SIM card memory). The last column, on the left represents applications that require a physical modification of the handset form factor or a specific chip.

The horizontal axe from right to left goes from the most secure scheme to the least secure one. The vertical axe, top down, goes from incumbent to newcomers.

As any classification system our matrix has its limits. Some payment schemes cross categories. and consequently appear in more than one cell. There are also cases where it is hard to decide if a scheme is of a card type or should be better addressed as phone-based. Nevertheless, we would like to point that we did not find any scheme that felt outside of the system and our typology resisted the test of about 40 mobile payment schemes. Following are cases illustrating each cell of the matrix.

Mobile Accessed Payment Scheme driven by Operator (Cell I)

Top-up services are typical examples of this category of payments. Top-up services allow prepaid users to refill their operator account balance.

Mobile Accessed Payment Scheme driven by Banks (Cell II)

rePower: is a MP procedure developed by MasterCard in South Africa. Cardholders register with their participating financial institution in the U.S. or with their wireless

carrier in South Africa, and provide their contact and payment information, their mobile phone number(s), and then select a rePower code or password for future authentication. The payment details are stored in a secure, password-protected account (server) for them to access whenever they'd like to replenish their prepaid accounts using their registered debit or credit card.

Mobile Accessed Payment Scheme driven by Newcomers (Cell III)

PaybyTel is a micro-billing solution for the Internet aggregated on the user's phone bill. When a user must pay something online, the Web site informs him of the premium number that he must call via mobile or a fixed line. The voice system gives the user the necessary access codes, which the user enters on the Web site of the merchant to complete the transaction.

Card Based Payment Scheme driven by Operator (Cell IV)

In this procedure, the operator associates a SIM card to a cardholder's payment card. There is no disintermediation of the banks and the network operator may be restricted to carrier status and excluded from any transaction revenue. This scheme requires collaboration between operators and financial institutions. An example of this payment scheme was mPay in Denmark. mPay was a card-based payment solution for remote sales, using the mobile phone as a payment terminal. mPay was operated by Orange/Mobilix and PBS an organization providing settlement services for the major network payments (Visa, MasterCard, JCB ...). The cardholder would make an agreement with the phone company and the merchant with PBS. The merchant would

receive information about the cardholder's mobile phone number instead of a card number. The mobile phone number was related to the cardholder's payment card and payments were accepted by using a PIN code on the phone. PBS would transfers the mobile phone number to a valid card number and processes the payment. Security elements were built into the SIM card (PIN code, encryption, transaction certificate).

Card Based Payment Scheme driven by Financial Institutions (Cell V)

As in the case for the procedure described for cell IV, this procedure also corresponds to a case where a SIM card is associated to a credit or debit card. However, here, a financial institution drives the procedure. VISA Movíl, provides a good example of this scheme. In Spain, VISA offers a mobile payment system where the mobile phone number is associated with a VISA card. In Internet purchases, the user provides his mobile phone number, and in real POS the merchant enters the payer's phone number via an ad hoc terminal. VISA Movil calls back the user, who authorizes the transaction with his PIN. In 2001, Caixa Movil (subsidiary of Caixa bank) joined the scheme. Therefore VISA Movil substituted the former Caixa Movil standalone solution. This scheme requires collaboration between operators and financial institutions. Spain is a good example of a market in which, after a strong push by the regulators, banks and mobile operators have worked together to launch MPS to the benefit of both the players and the market as a whole.

Card Based Payment Scheme driven by Newcomers (Cell VI)

Nokia is conducting a trial in Dallas and Orlando in U.S. in which a specially designed

contactless chip is integrated into the Nokia phones and associated with a pre-registered MasterCard account. The user pays by waving his mobile phone into a specially equipped PayPass at the POS. This new method, however, hardly adds anything to the standard method of swiping the credit card. MasterCard hopes to add an advertisement channel based on customer bases of each merchant.

Software Based Payment Scheme driven by Operator (Cell VII)

SmartPay is an electronic payment system offered in Norway by Telenor that uses PKI (Public Key Infrastructure). MobilHandel is the first application of SmartPay. PKI is used for authentication of the payer and the signing of the payment, and the bank account, credit card, or mobile phone bill is charged. This solution requires the replacement of the SIM card with a new PKI-enabled card[15].

Software Based Payment Scheme driven by Financial Institutions (Cell VIII)

We did not find any example for that category of payment what does not means that such service does not exist.

Software Based Payment Scheme driven by Newcomers (Cell IX)

SmartPAY of Echovox is a mobile micro-billing system for Microsoft Windows-powered smartphones that enables mobile software developers to bill usage of their application through a simple pay-per-use mechanism. The user downloads an application to his mobile device and he can then test the application once or twice. On the third trial the application prompts him for payment to unlock the application. The user accepts the

transaction and sends the required information. The SmartPAY platform queries the developer license server for the unlock sequence and sends it to the phone, therefore allowing the user to access the application. The user is billed on his phone bill for his software usage. Via its ICON (Inter-Carrier Open Network) coverage, application developers can distribute applications with this model throughout Europe (more than 36 mobile operators in 10 countries).

Phone Based Payment Scheme driven by Operator (Cell X).

This procedure involves a modified handset that contains a standard payment card reader. To authenticate the transaction the user passes their existing credit or debit card through the reader, and is required to enter a PIN. The PIN triggers an authorization request, which is sent to the customer's bank. Following authentication, the bank sends a confirmation SMS message to the merchant and user. At no time are confidential account or card details required to be transmitted over the wireless network. This procedure is best known for having been employed by the Paiement CB sur Mobile service tested by Orange in France between 2000 and 2003. This schemes required the collaboration of banks and operators. Banks maintained their control over the whole transaction and captured the totality of transactions fees. Operators would generate revenue from the SMS needed to perform transactions. The cost of SMS was charged to merchants.

Phone Based Payment Scheme driven by financial institutions (Cell XI).

The handset-based wallet payment procedure, sometimes called dual-chip handset, involves the payment information being stored on the handset, and encryption taking

place before transmission. This will usually involve a modified handset with room for a second chip, in addition to the mobile SIM card. The second chip could be issued by the user's existing bank or credit card association, and contains the same information as their standard payment card, such as account details and delivery options. In addition it could contain applications specific to the bank or credit card such as loyalty schemes or stock trading applications. This procedure keeps the banks in control of payments, and users could switch banks or operators at their discretion. From the operator's point of view, they are restricted to carrier status and can be excluded from any transaction revenue.

Phone Based Payment Scheme driven by newcomers (Cell XII).

In our example, a handset manufacturer storing a m-payment application in the phone. For instance, Nokia Payment Solution: Nokia has implemented an m-wallet in many of its phones, a password-protected area in the phone, where one can store personal information such as credit card numbers, delivery addresses, or loyalty card details. In September 2003, VISA Europe and Nokia agreed to enable mobile subscribers to make secure payments from their phone handsets by using Nokia's m-wallet application with "verified by VISA" authentication functions.

6.2 COUNTRIES OVERVIEW

We have tried to assemble the most comprehensive list of past and current MPS (Appendix 2). We found two main sources of reliable information. The first is the Bank for International Settlements (BIS), an international organization established in 1930 that

serves as a bank for central banks. The second is the IEEE, an independent association of a diverse group of industry professionals with a common interest in advancing all communications technologies. Still, we still have had to update the information listed as these database are not continuously updated. However, since many sites are in a local language and not in an international language such as English, German, etc or do not provide adequate information, the task of identifying precisely each service architecture was challenging and more time consuming than anticipated. Accordingly, the survey has to be restricted to major innovative solutions which have already established themselves in the market and does not include systems which are still in development or which are running as a very limited pilot project.

Figure 11: Overview of mobile payment schemes by country

Channel (callback, PIN, SMS, IVR)	Card based (WIM,SIM)	Software based	Phone/chip based	
United States of America				
Direct-Bill Mobilescape				Operator
			Visa & MasterCard with Nokia	Banks
PayPal Mobile MobileLime TextPayMe		Obopay		Newcomers
Europe (Austria, Denmark, France, Germany)				
	Mpay (D) ✕ Genion? (G) PayByPhone (A, G)	W-HA (F) PayBox (A), MIA (A), One (A)	Paiement CB sur mobile ✕	Operator Driven
PaysafeCard (A)	Quick (A)	Mpay (D)		Banks
Metax (D) PayBox (G) ✕ Street Cash (G) ✕ FitrstGate (G) Crandy (G),	BeamTrust ✕ (D) Zariba/Bluefish ✕ (D)	PhotoPay (G) Mobipay (A) ✕		Newcomers Driven
Japan				
	FeliCa	SuiCa	FeliCa	Operator Driven
				Banks
				Newcomers Driven

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6.2.1 UNITED STATES

Initially, we expect the US market to develop faster than the European one, where as we will see, the loops could not completely play. Payments networks are in best position to leverage their customer bases to compete for market standards or market niches (e.g., serving small retailers versus serving large retailers). Companies with a direct link to a vast customer installed based (transportation, entertainment etc.) could also become competitors to the incumbents. PayPal provides a good illustration of MP adoption dynamics in the US.

Perceived risk loop #1:

Among all the countries reviewed, US MPS are the least secured (a vast majority of mobile accessed solutions). However we estimate that the level of perceived risk is not deterrent. US authorities payment culture seems to favor a "light-handed" approach when evaluating the trade-off between security and innovation. Authorities are clearly more concerned about not stifling innovation and less concerned about providing highly secured transactions environments. Consequently, the fast roll out of new solutions create a solution rich environment that reduce customers perceived risk.

Cost/performance loop #3:

The model analyses changes in cost and performance from the supplier perspective. The credit card industry interchange fees structure leaves opportunities for more cost efficient payment solutions. All the more that interchange fees, presented in figure 12, have been rising as payments networks are passing fraud costs on to merchants. And MPS allow

substantial cost reduction. It is estimated that Bank Of America pays to payment networks 8 cents per $100 in credit card charges and 6 cents per debit card transaction totaling $70 million annually. Payments start-ups business models reduce transactions costs to both merchants and purchasers by redistributing part of these interchange fees. On the long-term, small merchants, who are the most sensitive to transactions costs are likely to favor alternative payments systems that are more cost-efficient (e.g.. PayPal). What on the long term may contribute to decrease the overall cost of transactions.

Figure 12: US Credit Card Merchant Service Fees and Interchange Fees

Sources: MasterCard; Visa
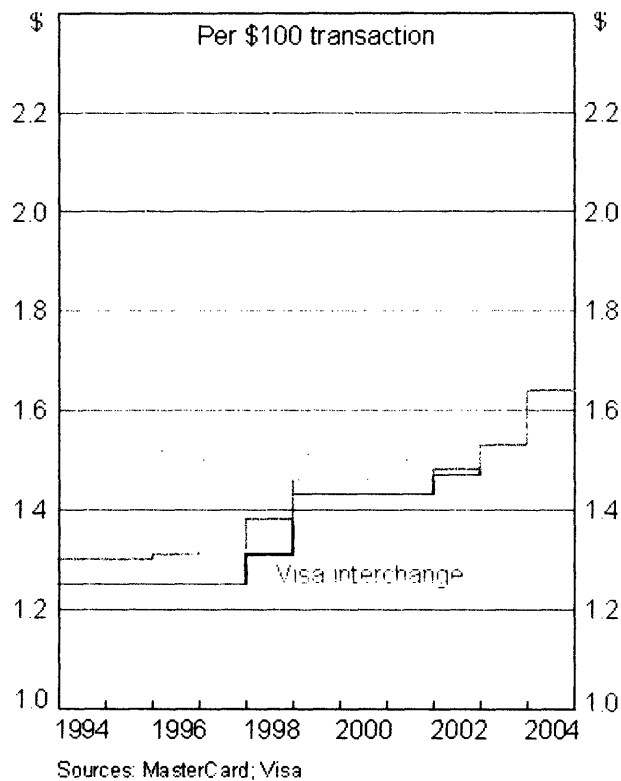
Emerging standard/Network effect loop #4:

Payment networks and banks are better positioned to create and benefit from a network effect because they have both the means (sufficient customer base to move the entire market) and incentive (as attested by past and current MPS experimentations) which is neither the case of operators nor start-ups, with the exception of PayPal.

Firstly, operators are rather absent from the MP space. They are absorbed by other trends affecting their industry (consolidation, converging media). We expect them to play a significant role as strategic ally of either handset manufacturer or banks/payment networks.

Secondly, new comers are VC-backed start-ups, most probably with buyout strategies, what ultimately, is likely to strengthen incumbents. Besides, as discussed in chapter four, these start-ups have to build their customer bases. Furthermore, any solution deployed by new entrants is more likely to be constrained by the lack of integration of the US payment system. Indeed, the image of the US as a homogenous market, comparable to a single European country, is somewhat misleading. The US has two systems for large-value transfers (Fedwire and Chips) and four central processors for ACH (Automated Clearing House – or giro) transactions. Cheque processing is in the hands of about 150 Cheque Clearing Houses. Different (regional) online debit schemes are not interoperable, the only national debit schemes being the offline debits of MasterCard and Visa. Similarly, there are regional as well a national ATM networks. While there is more integration than within Europe, there are also many developments along geographical lines.

Figure 13: The majors American mobile payment start-ups solutions

Company	Launch Date	Payment Initiation Methods	How Payment Authorized	Account Funding Methods	Withdrawal Methods	Consumer Distribution	Usage Fees
TextPayMe	Dec 2005	SMS-based	Callback, enter PIN via DTMF	ACH Bank Card	Wire to DDA Mailed Check	Direct via web	Free for now
PayPal Mobile	Mar 2006	SMS-based plus IVR option Text to Buy feature using SMS Short codes [Debit Card]	Callback, enter PIN via DTMF	PayPal account (ACH, Bank Cards, funds in PayPal account)	PayPal Withdrawal Options	100 MM enrolled PayPal users Direct via web	Same as PayPal (receiver pays above $500 monthly threshold)
Obopay	Apr 2006	Application on handset SMS fallback Debit Card	PIN used with handset application [For SMS?]	ACH Bank Card [Cash]	ACH Use adjunct MasterCard to shop, withdraw cash at ATMs	Direct via web Mobile Operators	Sender pays 10¢

Source: Payment News

PayPal provides a good illustration of a situation when the dynamics we have been discussing can freely play. With 45% of Internet users registered, and an emphasis on fraud management , there is perceived little risk in using PayPal. While, the payment system had benefited from is attachment to the world 11th largest retailers (PayPal claims 105 millions users worldwide at the end 2005 while American Express has 73 millions users and Discovery Card 50 millions users). Finally PayPal provides lower cost of transactions to both merchants and purchasers. By contrast, PayPal success pinpoints the incentives issues with operators and banks, which could have done the same, and the

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chicken and egg issue with small star-ups.

Figure 14: Leading Global Retailers

Company	FY 2005 Revenue
1. Wal-Mart Stores Inc.	$316B
2. Carrefour SA	$93B
3. Home Depot Inc.	$82B
4. Metro AG	$69B
5. Tesco PLC	$68B
6. Kroger Co.	$61B
7. Royal Ahold NV	$55B
8. Costco Wholesale Corp.	$53B
9. Target Corp.	$53B
10. Sears Holdings Corp.	$49B
11. eBay GMV	**$44B**
12. Lowe's Companies Inc.	$43B
13. Walgreen Co.	$42B
14. Albertson's Inc.	$40B
15. Safeway Inc.	$38B

Source 2005 Fortune Global 500 for the Food and Drug Stores, General Merchandisers and Specialty Retailers industries, updated for fiscal year 2005 revenue data publicly reported by each company and converted using the average foreign exchange rate for the respective fiscal year

Source: EBay, Analyst Day 2006 Report, May 2006

6.2.2 EUROPE[16]

The European MPS landscape offers striking contrasts between countries. There are clearly distinguishable MP cultures within Europe. Some of the payment schemes important in one group of countries are hardly used in others. There are also clear differences in the level of co-operation between banks, due to the degree of fragmentation of the banking sector and the decentralization of payment processing. Therefore some markets (Austria, Spain, Norway) have achieved a faster diffusion of MPS innovations than others.

However, if we consider the EU as a whole, at the European level, none of the key positive loops is generally staged to boost either people willingness to adopt or the

number of potential users. Nevertheless, there are many initiatives undertaken either by the key players or by the European Community to coordinate the emergence of standards. As a result we expect that the diffusion of MPS is likely to be much slower in Europe than in Asia and probably even in the United States, despite higher penetration rates of cell phone and smartcards. Unlike in the US, operators should be the driving force pushing MPS to the market.

Finally, a new breed of financial service companies is emerging as preferred provider of MPS platforms and services. Indeed, while "under current U.S. law, stored-value cards, smart cards, and e-wallets are being viewed as liabilities but not deposits, thus allowing non-banks to issue these instruments', in the EU, with the E-money Directive limiting the issuance of e-money to traditional credit institutions and to a type of supervised undertaking called e-money institution, a complex market situation is arising as many new entrants become "near-banks". In its 2005 survey of e-payment innovations, the European Central Bank found that two third if the e-money providers (what includes the MPS providers) are related to the banking industry[17]. A third are directly owned by the banking sector. Furthermore, substantial shares (36.1%) of the remaining companies (owned by non-banking sectors) have licenses[18] related to the financial sector, although they are not directly owned by this sector[19]. Two-thirds of the providers are thus related to the banking industry – either by license or by ownership. A possible explanation (or a mix of explanations) can be (i) that in most countries a banking license or an EMI license is needed before such services can be offered; (ii) the banking industry is in a better position to offer the full range of e-products, including settlement of funds; and (iii) that the public tends to trust the more traditional financial institutions, for example banks,

when it comes to the payment industry.

Perceived risk loop #1:

Both the dominant technological choices and the legacy of past experiences may contribute to a relatively high level of perceived risk. Europeans tend to be more sensitive to payments risk issues than Americans or Japanese. As a result players have less incentive to select the payments scheme that are easier to implement and provide less security. Instead, they must comply with high security expectation that require the alignment and coordination of many other participants of the value chain. Typically SIM and WIM based solution are very popular. Depending on countries, this may results in a lower number of solutions being pushed to the market, and consequently, less educated users with high-perceived risk.

The legacy of discontinued MPS experiences might reinforce the perceived risk of new MPS. As a matter of fact, not only has Europe experienced the most diverse MPS schemes, but also the highest number of MPS terminations (see figure 13). Those two factors combined may encourage customers to adopt a wait and see attitude because new payment systems might be deemed short-lived, hence 'suspicious', 'unstable' or 'risky'.

For all the reasons quoted above, the European 'perceived risk' loop has a strong negative impact stronger than the American or Asian ones.

Cost/performance loop #3:

The situation is similar to that found in the US, with the exception that the opportunity to improve payment efficiency is lower than in the US. Indeed, while in the US, debit cards

only became popular in the 90's, Europeans mostly use debit cards whose interchange fees are lower than that of credit cards.

Emergence of standard/Network effect loop #4:

Within the next three to five years, European players technological choices provide them with less ability to speed MPS adoption than their counterpart in the US or in to Japan. Firstly, due to the historically high degree of international collaboration between national incumbents[20], MPS innovation diffusion is likely to be fueled by the emergence of a constructed standard rather than that of an uncoordinated standard, unlike in the US or in Asia. However, the disintegration of SimPay at the end of 2005 will slow down standardization initiatives driven by operators and lead to a focus on national solutions in each market. SimPay was an example of standardization effort at an embryonic stage of a technology that was significant enough to deserve further details. The same way PayPal success illustrates the dynamics at play in the US, the same way SimPay failure illustrate those at play in Europe. SimPay was a global initiative created in 2003 by all four largest European operators (T-Mobile, Orange, Vodafone, Telefonica Moviles), as a 'Mobile Payment Services Association'. SymPay was founded with the goal to deliver a single open interoperable platform to deal with the routing, clearing and settling of mobile payments (micro/mini payments below 10 euros) in as many as 20 countries. It was felt that a standardized European brand would make the recruitment of merchants easier, and that large content providers such as EMI, Disney or Bertelsmann, would welcome the relationship with a single payment provider to be able to offer content directly to consumers. The consortium objective was to launch the technical solution at the end of

2004, and make the commercial service in early 2005 in order to achieve more than 1 billion euros of extra transaction for the mobile phone industry in 2007. However, it is said that the group was plagued by delays that ultimately led to its disintegration. Many other standardization consortia exist. There are mobile network operators driven consortia, banks driven consortia, cross industry driven consortia, Device manufacturers driven consortia. The most influential consortia (operators and banks) are dominated by Europeans companies.

Secondly, once aggregated in our matrix, the heterogeneous European solutions appear relatively homogeneous in term of technical choice. The majority of the solutions are card or software based, rather than mobile accessed, like in the US, which on the one hand is consistent with European financial institutions requirement for high security standards, but on the other hand implies a slower rate of adoption for new payment schemes (based on handset replacement rate) as well as a higher degree of coordination among players (operators, handset manufacturers, application issuer).

6.2.2.1 Case studies

Following are five case studies (Austria, Belgium, Denmark, France and Germany) that illustrate the variety of markets dynamics within Europe. Austria is generally considered the most advance European country in term of MPS, at the same level as Japan and Korea. At the other end, France MPS are embryonic while Germany, similarly to UK, Spain and Norway, is at its early/developing stage. Finally Denmark represents an interesting case where all MPS seem to have failed.

A. Austria: towards operators driven standard?

Telecommunications operators dominate the Austrian MP market. Austria is overcoming one of the major challenges critical for ensuring an open standard not specific to any operator or payment scheme and interoperable across platforms and services. In October 2005 „ONE", the third mobile operator announced that they had acquired a sixth of PayBox shares. Mobilkom Austria has always been promoting PayBox as the ideal platform for MP in the country. However, initially, the four other Austrian operators (T-Mobile, „ONE", Tele.ring and H3G) set up their own standard, MIA, and began to acquire merchants. We should expect to see the first combined MP offering from the 3 companies (mobilkom, „ONE" and PayBox) in the second half of 2006.

Competitive battles:

1. **Mobilpay ✂:** Mobilpay was a patented VirtualPOS. After the payer selects Mobilpay as the payment method, a one-time PIN is announced to the user's mobile phone via a voice service. By sending the PIN via SMS to the Mobilpay system the user authorizes the payment. The company failed to attract investors and ceased its activities around 2003/2004.

2. **PayBox and MIA:** The dominant MPS is operated by PayBox Austria, a subsidiary of the largest Austrian mobile operator (Mobilkom). PayBox enables payments via mobile phones using an automated voice-call system for payment confirmation and PINs for payment authorization. For a more detailed description of the

Channel	Card-based	Software-based	Phone-based	
PayBox	Pay-by-phone/ MIA -		-	Operator Driven
-	-	-	-	Banks/payment network driven
-	-	Mobipay ? ✕	-	Newcomers Driven

PayBox system, see the case study on Germany. Corporate companies are now also being targeted with the Business PayBox. Business PayBox can be connected to a company's ERP system and m-payment transaction initiated by the employees are automatically registered in the company's legal accounting system. Customers of this service report cost saving of more than 30 percent for the products bought through Business PayBox due to more transparent and manageable accounting process. Mobilkom Austria has always been promoting PayBox as the ideal platform for MP in Austria. However, initially, the four other Austrian operators (T-Mobile, „ONE", Tele.ring and H3G) set up their own standard, MIA and began to acquire merchants. MIA is less open and flexible than PayBox. While PayBox is open to corporate, pre-paid and other operators' customers, MIA only supports charges made to the customer mobile bill and thus is not accessible to prepaid subscribers nor to corporate customers without the authorization of the company that pays the bills. MIA is also growing much more slowly than PayBox in terms of merchants offering the solution.

3. **Pay-by-Phone (T-Pay):** "Pay by phone" (formerly known as banko.mat) is a service offered by T-mobile. The user has to register and get a PIN for transaction authorization. Services such as purchases of real-world goods, tickets, and lottery games are included. In Germany the same concept is marked under the T-Pay brand, which is a mobile wallet that can also accommodate other payment instruments such as credit cards.

B. Denmark: too complex solutions?

Denmark seems to have tested mostly SIM based solutions that are more complex to roll out and require more time to create a large base of potential users. Futhermore the market is driven by new entrants. Our hypothesis is that the combination of these two factors can help explain the failure of any MPS beyond Metax.

Competitive battles

Channel	Card based	Software-based	Phone-based	
-	-	Mpay ✖	-	Operator Driven
-	-	-	-	Financial Institution Driven
Metax	BeamTrust ✖ Zariba/Bluefish ✖		-	Newcomers Driven

1. **BeamTrust ✖:** BeamTrust was an inFr enabled mobile solution deployed in Denmark that had a wireless account-to-account payment system and aims at

migrating its solution toward the standards outlined by the Mobile Payment Forum. BeamTrust's solution required a mobile telephone with a special SIM card, a traditional cash register, and a newly developed payment terminal. The customer would accept his purchases by pointing the infra-red beam of his mobile phone at the payment terminal and by entering his digital signature. When the payment had been accepted, the customer would receive an electronic receipt on his mobile telephone. The approach allowed the payer to freely choose from which of his accounts he wishes the amount to be withdrawn. The transactions were stored on a server in the shop and could be cleared later or simultaneously with the transaction at the data center of each individual bank. All electronic receipts were stored in a database to which the customer has access via the Internet, and detailed information about all the mobile purchases could be found. Based on our visit on the company website, as of spring 2006, we believe that the company is no longer offering is MP solution. Instead the company is offering a service allowing its customer to consolidate and access all their receipts online.

2. **Bluefish and Zaryba** ✕: Bluefish and Zaryba offered at the beginning of 2003 a mobile post-paid bill payment solution. The application uses the SIMToolkit/SIM browser technology to create a menudriven interface by which users can view and pay their bills and also receive transaction confirmations. Payments were also made through a direct connection between the banks and clearing houses, the Zaryba transaction server and the network operator's billing system. Bluefish Technologies is a global supplier of SIM cards and SIM technologies to network operators. Zaryba

was a global provider of mobile payment solutions to mobile operators, banks and the payment industry. As of spring 2006, we believe that the companies solution is no longer operating.

3. **Metax**: offers petrol payment via mobile phones (a patented concept) in Denmark. The mobile phone is used as a replacement for a METAX credit card, therefore the customer still receives a monthly invoice from Metax even though a mobile phone is used. The user calls a free phone number and is invited to enter their PIN (provided by Metax), after which they can use the station's pump.

4. **mPay** ✕: As of spring 2006, we could not find trace of the mPay solution online. Therefore, we assume that mPay system is no longer operating. mPay was a card-based payment solution for remote sales, using the mobile phone as a payment terminal. mPay was operated by Orange and PBS an organization providing settlement services for the major network payments. The cardholder had to make an agreement with the phone company and the merchant would make an agreement with PBS. The merchant received information about the cardholder's mobile phone number instead of a card number. The mobile phone number was related to the cardholder's payment card and payments were accepted by using a PIN code on the phone. PBS transferred the mobile phone number to a valid card number and processed the payment. Security elements were built into the SIM card (PIN code, encryption, transaction certificate).

C. France: competition between banks and operators

After an early experience with a pioneering phone-based solution, the 'Paiement CB sur Mobile' the French market is now inactive. Banks and operators are entrenched in strategies that do not require any collaboration with any other part of the payment supply chain. The Kiosk model driven by operators dominates the French MP market. This model is the legacy of the 'Minitel', an early online network that experienced a tremendous success in the country before the emergence of the Internet. In the "kiosk" model, the mobile operator provides access to services conceived by service providers, aggregates funds it receives from the customer in payment for the access and transfers a part of these funds to service providers, keeping the balance in remuneration of its services. Kiosks can use voice, SMS and WAP/internet. They are designed for micropayments and do not require any equipment other than the conventional GSM phone. Bouygues, SFR and Orange, the three national wireless operators have implemented such solutions.

The WAP kiosk of the first national operator, Orange, is based on Valista (ex IPIN technology) and named w-HA. w-HA has received a first degree license as a financial institution. On the long run, similarly to NTT-DoComo in Japan, Orange is likely to operate as a near bank as the Bank of France holds the view that the issuance of e-money has to be restricted to credit institutions. The termination of the 'Paiement CB sur Mobile' service illustrates the failure of banks and operators to collaborate. Both players are now operating parallel payment systems independent from each other. Operators with the kiosks, Banks with e-purse embedded in credit and debit cards (Moneo). Operators and banks are displaying a monopolistic behavior preserving their direct relationship with

their respective customers and excluding each other from their 'natural territory'. Even if their monopolist footprint are not large enough to force their rivals to stay out of the market completely, exclusion from part of the market is putting potential rival at a severe competitive disadvantage by forcing them to operate at a less efficient scale (e.g.. high cost of SMS) or with a smaller network. What can explain why, to our best knowledge, no new entrants has tried to enter the French MPS market, except as a payment platform provider. Compared to a world without exclusion, this monopolistic behavior may slow down the erosion of banks and operators monopolies, preserving their ability to charge monopoly profit for a longer time.

Competitive battles

1. **Paiement CB sur Mobile ✂:** The service used a dual-slot phone, SIM Toolkit-based cards, and SMS messaging. The payer provided his mobile phone number to the merchant, an SMS notified him about the transaction details, and then the smart card was inserted into the dual-slot phone and the PIN typed. When the bank had authorized the transaction, a confirmation message would be sent by the bank via SMS to the payer, and the merchant would also receive a payment confirmation.

Channel	Card based	Software-based	Phone-Based	
-	Paiement CB sur Mobile ✂-	W-HA WAP I-Mode	Paiement CB sur Mobile ✂	Operator Driven
-	-	-	-	Financial Institution Driven
-	-	-	-	Newcomers Driven

2. **W-HA**: W-HA is a microbilling solution based on iPIN's platform (now acquired by Valista). Goods can be purchased, and the charges are made on the MNO bill or in the credit/debit card (if the user has an iPIN account).

D. Germany

Contrarily to France, there are many fluctuations on the German market. Besides, new comers, are particularly active on this market. Some have been successful over the last past years, other have discontinued their business after a short time.

<u>**Competitive battles**</u>

Channel	Card based	Software-based	Phone-Based	
-	Genion Pay-By-Phone ?		-	Operator Driven
-	-	Mobilbank ?	-	Financial Institution Driven
PayBox ✗ Street Cash ✗ FirstGate/Click&Buy Crandy	-	PhotoPay,	-	Newcomers Driven

1. **PayBox** ✗. Launched in Germany in may 2000, PayBox was for a long time acknowledged as one of the most successful MPS venture worldwide. PayBox as a service was offered in several real and virtual POS ranging from cabs to online transactions at ebay.de. PayBox discontinued its mobile payment service at the beginning

of 2003, and began to operate as an service provider developing and supporting mobile services and payment applications for banks, telecommunications companies and local payment processors. **The PayBox system was a complete and rare disintermediation of banks.** Its basic approach is still of significance and because the discontinued business in Germany is carried on by the mobile service provider Moxmo (Nederlands), while in Austria (where in 2004, the venture claimed 100,000 users), PayBox service is now owned by the country second largest mobile operator. PayBox is a system for payment via mobile phone on the Internet as well as at POS and P2P at the national or international level. In order to be able to participate in the system, the customer has to be registered with PayBox (including the direct debit authorization for the customer account) and possess a PIN provided by PayBox. For offline retail payments (when the retailer also uses a mobile phone to get paid), or for P2P transactions the procedure is as follows. The payer communicates his/her phone number to the retailer, who is also registered with PayBox. The supplier transfers this phone number and the price to the PayBox server. PayBox calls the payer and informs him/her of the amount and the name of the retailer. The payer authorises the payment by inputting his/her PayBox PIN. After settlement of the payment, PayBox sends an acknowledgement to the customer and gives a receipt of the success of authorization to the retailer. Later on, the payer's account is debited by direct debit and PayBox credits the amount to the retailer's bank account. Moreover, PayBox users can also transfer money to each other. The sender calls PayBox, feeds in the receiver's mobile phone number and the amount to be paid and acknowledges the payment using his/her PayBox PIN. In the case of transfers, the payer fills in a transfer form on the PayBox homepage and gives his/her mobile phone number.

After completing the form, PayBox calls the payer and requests transaction authorization by means of the payer inputting his/her PayBox PIN into the mobile phone. Next, the payer's account is debited and the receiver's account is credited. The receiver is informed of the payment by personal e-mail. Registration with PayBox is performed using an SSL-encoded data line. The PayBox procedure uses the buyer's mobile phone number. By means of the SIM chip inside the mobile phone, the customer can clearly be identified and communication is performed through a secure channel within the operator's GSM mobile network.

PayBox acts as a neutral payment intermediary aiming at independence from telecom operators through a recognized brand and does not require any special mobile phone characteristics. However, the approach is not cost-effective (SMS and voice-based communication) and the PIN is transmitted via normal DTMF (Dual Tone Modulation Frequency) procedure. The problems that forced PayBox to restructure include the slow development of the m-payment market, the prolonged poor investment climate following the end of the dotcom era, and industry's unreadiness and lack of cooperation, particularly among banks and telecommunication providers, and the potential providers of a mass-market MPS.

2. Street Cash ✕. The mobile payment procedure Street Cash provided by Inatec in Leipzig was based on text messaging and could be operated with all SMS-compliant mobile phones. In contrast to PayBox, Street Cash was not a separate mobile payment procedure but is integrated into the multipayment platform powercash21. This scheme allowed bills to be paid by SMS. After having successfully registered address and bank

account details with Street Cash, the customer was given a secret PIN. The retailer initiated the bill. An SMS including the price and the customer's phone number was transferred to Street Cash. Following this, Street Cash send an SMS to the customer, who had to confirm the price by in putting his/her PIN. Then, after the data had been verified, an SMS containing the confirmation was sent to the retailer. The money was debited to the credit card account that has been indicated by the customer. The SMS messages were encoded over the GSM network and securely dispatched. No personal data of the customer were transmitted during the payment transaction.

3. Firstgate click&buy. Firstgate click&buy is a microbilling system for digital content on the internet and mobile platforms and is operated nationwide. We have been unable to find a description or a demonstration of a mobile payment transaction but will describe an Internet payment. A purchase on the internet is executed as follows. The user registers online, selects a password, is given a PIN and submits a preauthorized payment mandate to pay monthly by credit card or direct debit. If the customer wishes to buy content, he/she has to click the respective button of the retailer. After having fed in his/her username and PIN, the customer is presented with a page inserted by Firstgate, which again names the retailer, type and price of the ordered content. The customer has to accept this price by means of a click in order to be able to download the content. The accumulated costs are debited to the customer's account once a month and the proceeds are credited to the retailers' accounts.

4. Crandy: In mid 2003, the NCS mobile payment bank was established with the objective to further develop and launch Crandy. Crandy offers to registered users real-time payments for goods. They have an IVR and a Java interface. It is a typical prepay service with online account management. The company has been cranted e-bank license from the Federal Institute of Financial Services Supervision in Germany and as an independent mobile payment provider, can process non-telecom related services over the mobile phone.

5. MobilBank ✕: Mobilcom and Landesbank Baden-Württemberg joined forces and created MobilBank, which offered mobile payment services via WAP and SMS at the first stage, as well as more advanced services with the introduction of UMTS infrastructure. As the customers of the mobile payment service had a bank account with MobilBank, real-time checking of available funds was possible. A SIM toolkit allowed encryption of SMS. The project started in January 2001 but was stopped in May 2002 due to limited interest from the customer side (according to their press release).

6. Genion m-payment: Genion m-payment is a mobile payment service developed by Virbus and offered by O2 in Germany. There is a choice between WAP (PIN authorization) and SMS (TAN - one-time authorization code). In the latter and when shopping in a VirtualPOS, the user is redirected to the Genion m-payment server, where he logs in. The server sends via SMS a TAN to the customer in order to authorize the Internet purchase. Both parties (merchant and customer) are notified for the success of the transaction. The Internet part is SSLsecured, and it is planned that digital signatures

will be added as a capability to the SIM and to extend to real POS. Processing is done by Telecash, a clearing house subsidiary.

7. PhotoPay: Fun communications has developed fun PhotoPay, an MP procedure for the Internet and virtualPOS, which requires a camera-enabled mobile phone. When the customer makes a payment, all the relevant data is displayed on a monitor. The customer then starts the PhotoPay application and takes a photograph of the screen contents, which is composed of special symbols or barcodes. The application decodes these contents, and lets the customer select the preferred method of payment (e.g.. credit card, online bank transfer, or direct debit). The application stored on the mobile phone builds up a connection to the payment service provider's server and transmits the relevant data. The server receives the payment order from the fun PhotoPay application, carries it out (e.g.. by sending the card details to the credit card company, performing an online bank transfer or by submitting a direct debit order), and then notifies the customer and the shop about the status of the transaction.

8. Pay-by-Phone/T-Pay: "Pay by phone" (formerly known as banko.mat) is a service offered by T-mobile. The user has to register and get a PIN for transaction authorization. Services such as purchases of real-world goods, tickets, and lottery games are included. In Germany the same concept is marked under the T-Pay brand, which is a mobile wallet that can also accommodate other payment instruments such as credit cards.

6.3 ASIA

We will focus our analysis on Japan with one case study on China. Japan today is at the leading edge of mobile payment technologies. China represents a unique case of total collaboration among all participants.

A. JAPAN: Coordinated alignment of the supply chain

With a weak negative influence of 'perceived risk', not inhibiting 'cost/performance' expectations and a, government-backed dominant operator, the leading force driving the Japanese market growth is the historical operator, NTT DoCoMo.

In response to a mobile voice market that was quickly becoming saturated, NTT DoCoMo has moved into m-payments as both an application and business platform provider (see figure 14). Today Japan is at the leading edge of MPS. The Japanese market may have begun to structure around an open design, the FeliCa chip. Felica (Felicity Card) is a contactless card technology developed by Sony in the early 1990. The chip has a wide range of applications including commuters pass, ID card and quick payments at merchants POS. FeliCa enables four separate payment platforms that both compete and cooperate.

Perceived risk loop #1

Japan has both a low rate of credit/debit card fraud and a low rate of mobile phone thief. Despite that, with a chip-based service, NTT is implementing the highest level of security. For instance, DoCoMo's last phone, the DCMX' credit-card phone use the

phone's e-money FeliCa chip with no authentication required. For macro payments, the DCMX credit-card function works with a swipe and a PIN. Customers who lose their mobiles can call a number and remotely lock all functions by dialing their personal identification numbers. The perceived risk from customers is the lower among all nations we have compared. Therefore, we believe that, unlike the dynamics going on in the other countries, in Japan, this negative loop does not have a significant effect.

Cost/performance loop #3:

It is difficult to tell to which extend the lower cost or performance of SuiCa are a driving force. Customer appetite for the latest technological innovation seems a more accurate driver. Therefore one cannot necessarily conclude that among all the attribute of the new product, cost and performance are key attributes to foster customer adoption of MPS.

Standard/Network effect loop #4:

With a commanding 54% market share, NTT DoCoMo, the Japanese mobile giant owned by the telephone company Nippon Telegraph and Telephone has been able to impose top-down solutions to its market and benefit from network effect. Some 20 million Japanese now have newer cell phones with embedded circuitry that can function as rechargeable debit cards, credit cards or commuter passes. Electronic readers in vending machines, turnstiles and store registers beam waves that read the circuits and deduct what's due. Already, 30, 000 vending machines, taxis and convenience stores have readers for the wireless credit phones, and the number may climb to 100, 000 by the end of the year. Obvious platform leader for mobile payment, DoCoMo seemed at a certain time limited

by its lack of experience in credit. Its recent alliance with Sumitomo Mitsubishi bank should make up for that weakness. In April 2005, NTT DoCoMo entered an alliance with the Sumitomo Financial Group (SMFG) under which NTT acquired 34% of Mitsui Card, the credit card issuer of SMFG. According to NTT Management, the operator is planning to become a credit card company by developing its own credit card brand, dubbed 'iD' launched on December 2005. Initially iD is licensed to other banks and credit card issuers whose users will be able to make credit card payment via their mobile phone linked to their credit card. Subsequently, NTT DoCoMo will gradually become accredit card issuer itself. Owners of i-Mode Felica handset will be able to use them to make credit purchase (up to 10,000 yen). Initially, the statement of these expenses will be sent separately, but in the future it will be presented as part of the i-Mode bill. In order to exceed the pre-set monthly limit, one would have to apply for a credit account with NTT DoCoMo.

Finally we can wonder whether the Japanese market has not start to structure around the FeliCa chip. FeliCa enables four separate payment platforms that both compete and cooperate given the interdependent relationships inherent in the Japanese ecosystem that this chip enables.

Competitive battles

Channel	Card based	Software-based	Phone-Based	
-	Felica	SuiCa	Felica	Operator Driven
-	-	-	-	Financial Institution Driven
-	-	-	-	Newcomers Driven

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FeliCa/SuiCa: In 2004, Sony and NTT DoCoMo formed FeliCa Networks a 60/40 joint venture. When Sony's FeliCa chips were introduced initially, their only application was embedded in plastic cards. FeliCa Networks began to make and license FeliCa chips for use in mobile phones and is now pioneering the e-wallet in Japan. For now, feliCa Networks makes it revenue by licensing its technology to the other carrier in japan (KDDI, Vodafone) and to chip manufacturers and by providing platform management services to those who develop FeliCa applications as well as to those who use them. These services include managing the servers to download applications, authenticating users and managing the memory on the chip. In January 2006, NTT Docomo had sold 7 million FeliCa equipped handsets and was expecting to reach 10 million by March.
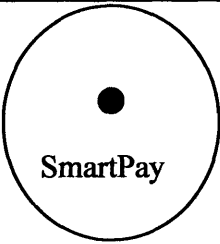
B. CHINA: Collaboration between bank, operators, merchants

There are about 300 million mobile phone users in Mainland China, but only a small number of credit cards in circulation, forming a good market foundation for MPS. Starting 2004, the two major mobile network operators, China Mobile Communications Corp., China Unicom Group, and a few start-ups, have been developing systems that link consumer's mobile phones to their bank accounts. Mobile phone users may pay telephone fees, book tickets and purchase goods and services by mobile.

Most mobile payment services are jointly provided by banks, mobile phone operators and merchants. Nowadays, banks perform funds settlement for mobile payments between mobile phone operators and merchants. Merchants may pay mobile phone operators in

terms of transaction volume or as a proportion of transaction value, and mobile phone operators and merchants may pay settlement banks a proportion of settlement amounts. As regards security, mobile phone operators are generally responsible for encryption of payment instructions in the process of transmission.

Competitive battles

Channel	Card based	Software based	Phone based	
-	-	● SmartPay	-	Operator Driven
-	-		-	Financial Institution Driven
-	-		-	Newcomers

1. SmartPay. SmartPay allows Chinese mobile phone users to pay for goods and services through their mobile phone. The company has partnerships with seven banks, including two of the country's largest state-owned institutions. China construction Bank and Agricultural Bank of China. It offers services in five province with plans to add one additional province per month. At the end of 2004, SmartPay had 100,000 registered users. SmartPay gets customers and marketing from China Mobile and China Unicom in exchange for a share of revenue'.

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APPENDIX 1: REGULATORY ENVIRONMENTS

US E-money Payment Regulation. Text reproduced from Epso Obervatory (European Central bank) 2001

'In contrast to many European central banks, the Fed took a fairly relaxed view on emoney, arguing that early regulation might stifle innovation. This difference of attitude between the Fed and the ECB has sometimes led to the general judgment that payments are heavily regulated in Europe whereas regulators in the US supposedly intervene very little. However, such a view is mistaken. A closer look at payment regulation in the US shows that there are many layers, coming from federal agencies as well as from the states.

The Federal Reserve System is responsible for the safety and validity of the payment system. It achieves this by prudent supervision of banks and the imposition of controls on those wishing to use the Federal Reserve's settlement services ("Fedwire"). These two tasks do not automatically extend to non-bank issuers of e-money. *"Under current U.S. law, stored-value cards, smart cards, and e-wallets are being viewed as liabilities but not deposits, thus allowing non-banks to issue these instruments"* (Mester 2000, 16). This is a very important point. The decision to classify these items as "liabilities" rather than "deposits" makes it possible for non-banks to issue the corresponding payment products. *Regulation E*: The Fed's

"Regulation E" includes provisions to protect consumers. Regulation E implements the Electronic Funds Transfer Act and applies not just to banks but also to non-banks offering electronic payment services (Mester 2000, 16). However, the areas to which Regulation E applies often remain open to dispute (Vartanian 2000).

State Money Transmitter Laws: Non-banks that offer payment services are subject to a number of regulations. In 44 States the issue of physical stores of value is regulated (reserve requirements, capital requirements, licensing, etc. (Mester 2000, 16)). As nonbanks have found it very difficult to comply with laws that vary from State to State on a nation-wide basis, State regulators now attempt to create a uniform legal framework (see below).

State Banking Laws: If a payment service provider offers an e-payment product that is linked to an account he may be regarded as engaging in the business of banking. For instance, when Florida State University issued smart cards this was regarded as engaging in banking business by the state authorities (Vartanian 2000).

The Federal Deposit Insurance Corporation (FDIC): E-money may or may not be regarded as a deposit depending on "where the money actually is". If it is a deposit, it is insured and falls under federal banking regulation (Vartanian 2000).

Anti-Money Laundering Regulations: The demand of the citizens and companies may clash with the requirements of law enforcement agencies especially when it comes to anonymous e-money products. In particular, such products may make it more difficult to monitor money laundering (Vartanian 2000).

Proposed Changes: In July 2000 the National Conference of Commissioners on Uniform State Laws agreed on a proposal for a "Uniform Money Services Act" (UMSA).5 The aim of the UMSA is to provide a uniform framework for the regulation of the different "Money Service Businesses" (MSBs) and to harmonise the regulation of MSBs across the states. The UMSA has a number of interesting features. The UMSA treats issuing emoney as a "Money Service Business" like traditional money transmission services (e.g.. wire transfers) or sales of payment instruments (e.g.. traveller's checks). Thus, issuers of emoney (the e-money service providers) are treated like other non-banks that have traditionally been active in the payment business. The UMSA does not mandate redeemability. In fact, the authors are quite aware of the different schemes that issue nonredeemable value points. (They even cautiously propose to exempt local exchange initiatives.) Permissible investments cover a much wider range of assets than the E-money Directive. The UMSA does not include any consumer protection provisions.'

APPENDIX 2: INDEX OF MOBILE PAYMENT EFFORTS

Most of the text listed below was originally compiled from two sources whenever relevant, we have added updates. The sources are either the European central bank observatory (http://www. Epso.net) or Stamatis Karnouskos, Fraunhoer focus paper 'Mobile payment, journey through existing procedures and standardization initiatives', IEEE Communications Surveys & Tutorial, Fourth Quarter 2004. These database are public and Epso functions as a Wiki (free of copyright and collective posting).

1. Bango.net: Bango.net (www.bango.net) is a mobile services provider that acts as a payment gateway for operators across Europe for the purchase of mobile content. Mobile credit/debit card payments are possible, and the funds are subsequently transferred to the content provider's account. The payment can also be done by using a prepaid account, premium SMS, or operator billing. Lately Bango has been integrating the Simpay mobile payment standard into its payment platform.

2. Bankpass Mobile: Bankpass Mobile (www.bankpass.it) is a server-based mobile payment solution. It will be an SMSbased service capable of handling peer-to-peer fund transfer.

3. BeamTrust: BeamTrust (www.beamtrust.com) is a mobile solution deployed in Denmark that has a wireless account-to-account payment system and aims at migrating its solution toward the standards outlined by the Mobile Payment Forum. BeamTrust's solution requires a mobile telephone with a special SIM card, a traditional cash register, and a newly developed payment terminal The customer accepts his purchases by pointing the infra-red beam of his mobile phone at the payment terminal and by entering his digital signature. When the payment has been accepted, the customer receives an electronic receipt on his mobile telephone. The approach allows the payer to freely choose from which of his accounts he wishes the amount to be withdrawn. The transactions are stored on a server in the shop and can be cleared later or simultaneously with the transaction at the data center of each individual bank. All electronic receipts are stored in a database to which the customer has access via the Internet, and detailed information about all the mobile purchases can be found.

4. Bibit: Bibit (www.bibit.com) specializes in international Internet payments, allowing the consumer to pay a foreign Internet retailer using a payment method that is common in his own country. Among other payment types, Bibit offers mobile, WAP, and peer-to-peer payments by introducing country-specific m-payment existing services. Mobile Payments are possible via their "Mobile Payment Suite," which uses platforms such as i-Mode and "Vodafone Live."

Bluefish and Zaryba: Bluefish (www.bluefish.com) and Zaryba (www.zaryba.com) offered at the begin of 2003 a mobile post-paid bill payment solution. The application uses the SIMToolkit/SIM browser technology to create a menudriven interface by

which users can view and pay their bills and also receive transaction confirmations. Payments are made through a direct connection between the banks and clearing houses, the Zaryba transaction server and the network operator's billing system.

6. CabCharge: Wireless payment terminals are being installed in cabs in several countries, including the UK, Australia, Dubai, Japan, and the U.S. The aim is to provide legacy credit card payments via mobile POS in cabs. The most widely known is the Australian CabCharge (www.cabcharge.com.au), which validates Mobile POS Payments over a GPRS network. The POS simply connects to the acquiring bank via the mobile network operator, and fares and tips are automatically paid into a driver's bank account.

7. Caixamovil: The Spanish bank Caixa offered the "Caixamovil" payment system to its customers who have a credit or debit card. Mobile phone numbers are linked with a credit/debit card. On the Internet the user provides his phone number, while in a real POS the merchant dials the customer's number from an ad hoc terminal. The procedure ends with the user authorizing the transaction via his PIN when "Caixamovil" calls back. The system is substituted by VISAmovil (since May 2001).

8. Clear2Pay: Clear2Pay (www.clear2pay.com) is a Brussels-based company that offers payment solutions for the international financial industry. They enable banks to offer account-based payments to their customers via wireless channels (SMS-based messages, call centers, 3G interfaces) and mobile network operators to join in via their eWallet Solution. The user has a pre-paid account where all charges are made.

9. Contopronto: Contopronto (www.contopronto.com) is a MP procedure in Norway that realizes a server-based mobile wallet linked to a GSM mobile number. Users can make P2P and Internet payments and withdraw cash. It is SMS-based.

10. Crandy: This company (www.crandy.de) offers to registered users real-time payments for goods. They have an IVR and a Java interface. It is a typical prepay service with online account management.

11. Cyber-COMM: Cyber-COMM (www.cyber-comm.com) was a SET-compatible solution for payment on the Internet, via bank smartcard readers. The service probably stopped being operational in 2001.

12. DirectBill: Cingular (www.cingular.com) is the first company to offer wireless micropayment services in the United States via its DirectBill product. It is a MNO-assisted microbilling solution where the user can make purchases that appear on the monthly MNO bill.

13. DoCommerce: Japan's major mobile operator, NTT DoCoMo (www.nttdocomo.co.jp), is offering "DoCommerce," a secure mobile payment service, to its i-mode subscribers. Currently the service is offered in cooperation with

Mizuho bank (www.mizuhobank.co.jp) in Japan, but several other providers integrate this as an alternative solution to their services. Lately, NTT DoCoMo has offered to subscribers with 2G and 3G SSL-compliant handsets, the capability to pay online with VISA or JCB credit cards. The 'DoCommerce' aggregation service has already attracted thousands of customers, who can use a single password and screen to check their account balances with the 18 banks and credit card companies participating in the initiative. In July 2004 NTT DoCoMo launched a mobile-wallet system within the i-mode handsets that is based on Sony's FeliCa smartcard.

14. Earthport: Earthport (www.earthport.com) offers worldwide (70 countries) cash transfer via several channels, including SMS, Java2 Micro Edition, WEB, and WAP. Payments are carried out between two parties who are registered to the system and have linked their bank accounts/credit card or have made a cash transfer to an Earthport account (V-account). The user can retransfer back the money to his bank account if he wishes, which differentiates Earthport from the standard pre-pay models. Furthermore, charging to the V-account can be done at the micro level, which enables micro-payments and at multiple currencies. Earthport has a bank-centric business model, whereby the money never leaves the banking system.

15. Easybuy: Easybuy is a m-payment solution for the Internet offered in Italy by i-TIM (www.tim.it). The payer must provide his credit or debit card to any Automatic Teller Machine (ATM) of an EasyBuy participating bank in order to enable future EasyBuy transactions to take place. In the merchant's site the payer's phone is provided and a SMS notification invites him to authorize the transaction via his PIN. The solution requires a SIM card with 32 Kbyte of memory, and one can optionally use the service with an iTIM WAP phone, whereby the Internet transaction and payment are both carried out over the same mobile phone.

16. Echovox SmartPAY: SmartPAY of Echovox (www.echovox.com) is a mobile micro-billing system for Microsoft Windows-powered smartphones that enables mobile software developers to bill usage of their application through a simple pay-per-use mechanism. The user downloads an application to his mobile device and he can then test the application once or twice. On the third trial the application prompts him for payment to unlock the application. The user accepts the transaction and sends the required information. The SmartPAY platform queries the developer license server for the unlock sequence and sends it to the phone, therefore allowing the user to access the application. The user is billed on his phone bill for his software usage. Via its ICON (Inter-Carrier Open Network) coverage, application developers can distribute applications with this model throughout Europe (more than36 mobile operators in 10 countries).

17. EMPS: The Electronic Mobile Payment Service is a mobile-commerce pilot of Nokia, VISA, and Nordea (www.nordea.com), using dual-chip WAP phones (SIM+WIM), an EMV WIM card issued, and the VISA Open Platform. Over the first half of 2001 the pilot offered remote payment (also via the Internet) and log-on to electronic

banking. Real POS payment was also planned. In its second phase, the pilot used local communication technology such as infrared and Bluetooth, and targeted the wireless download of applications onto a bank card using VISA Open Platform. EMPS is associated with the technological choice of separating SIM and WIM chip cards (as also supported by Mobey Forum) and the resulting business model of bank/MNO collaboration, keeping separate the payment function (via the WIM card controlled by the bank) and the network function (via the SIM card controlled by the network operator). In 2003 the EMPS pilot has again been started in the Helsinki metropolitan area in Finland.

18. EMT: EMT (www.emt.ee) and Radiolinja (www.radiolinja.ee) offer m-payment services in Estonia. In order to pay for a service, the payer must call a special number or send an SMS. Mobile parking (m-parking.emt.ee) is a successful service launched in Estonia and lately in Norway, and has also been one of the finalists in the 2002 Stockholm challenge award (www.challenge.stockholm.se) in the category "e-business." Other featured services include buying goods and charging them to an m-account. The customer must make an agreement at an Internet bank (hanza.net and U-Net) by specifying the amount to be deposited to his personal m-account.

19. FairCash: FairCash (www.e-faircash.com) is a prepaid payment system solution that can accommodate micro and macro payments. Cash is represented by encrypted tokens stored on a reloadable and secure "Safe Valuta Storage" device" (SVS), based on the fairCash-PAY-Chip, acting as a local storage personal payment server. In peer-to-peer transactions, fairCash value tokens flow directly from one fairCash chip to another fairCash chip, and no third-party intermediary clearance takes place except of the holders of the two fair- Cash chips. The latter really enables payments as with cash today, and with less fraud risk due to a double spending database maintained by the fairCash issuer. The platforms through which fairCash can be used cover a variety of existing technologies and devices, including mobile devices.The user receives (against a deposit, an accout, or credit card debit) a set of tokens transferred to his SVS device, and the encrypted serial number of the fairCash tokens is entered in the double spending DB owned by the issuer. These tokens can be passed on to any other SVS device until their maximum hop-count is exhausted or when their expiration date is reached, after which tokens can only be transferred back to the initiator for clearing. All SVS will maintain a local log of tokens received together with the ID of the transmitting SVS, which provides the user with a means to prove his innocence with regard to counterfeiting 'money'. The analysis of that log requires the cooperation of the owner, as centralized log data bases are not supported. FairCash uses PKI certificates, various encryptions algorithms, double spending DB, zero-knowledge proof/authentication, and enhanced modified blind signature issuing protocol to provide a secure solution.

20. Fastpay: FastPay (www.fastpay.com) is a system that integrated Magex and offers person-to-person fund transfers via email and mobile phone. The charges are made on the user's credit/debit card or UK-based bank account.

21. Firstgate Click&Buy: Firstgate Click&Buy (www.firstgate.de) is a microbilling system for digital content on the Internet and on mobile platforms. Several billing models are supported, e.g. payment per click, per item, per time, per view, subscriptions, etc. The purchases are not debited directly but are aggregated and charged later in the payer's bank account, credit/debit card, or MNO bill. This approach is used by more than 2000 providers worldwide, including RTL, bild.de, Spiegel.net AG, Deutsche Post, UNICEF, BT (www.btclickandbuy.com), and ePaymentsnews.

22. Fundamo: Fundamo (www.fundamo.com) is a mobile payment system that realizes real-time transactions primarily in Africa. It enables its users to make payments, with value stored on a server, from mobile-to-mobile, mobile-to-POS, and mobile to Internet. Inter-Fundamo payments do not require a clearance period, and these funds are immediately available. Fundamo Payment Gateways (FPG) can be operated by a bank in order to have its legacy accounts Fundamoenabled. For non-banking institutions that operate an FPG, it is possible to offer peer-to-peer payments between Fundamo users. Fundamo has undertaken several measures to provide a secure environment. All links between FPG-to-FPG and FPGto- third party applications are based on secure links, e.g. shared symmetric keys (3DES for GSM or SSL for Internet) between FPGs and Fundamo-enabled handsets, and POS devices enable encryption of information between and authentication of these devices. Security mechanisms have been designed for both SAT (SIM Application Toolkit) and WIG (Wireless Internet Gateway) handset implementations. To partners using its technology, Fundamo provides a certification system, including a set of rules and principles with which they are required to comply. Transfers between the various parties are performed via dedicated lines and private networks, and encryption is again required. Mobile phone-based transfers are authorized by the user with their PIN. Even if the user initiates the transaction on the Internet, the notification is still sent to the mobile phone of the payer for authorization.

23. Genion m-payment: Genion m-payment is a mobile payment service developed by VIRBUS (www.virbus.de) and offered by O2 (www.o2online.de) in Germany. There is a choice between WAP (PIN authorization) and SMS (TAN - one-time authorization code). In the latter and when shopping in a VirtualPOS, the user is redirected to the Genion m-payment server, where he logs in. The server sends via SMS a TAN to the customer in order to authorize the Internet purchase. Both parties (merchant and customer) are notified for the success of the transaction. The Internet part is SSLsecured, and it is planned that digital signatures will be added as a capability to the SIM and to extend to real POS. Processing is done by Telecash (www.telecash.de), a clearing house subsidiary.

24. GiSMo: GiSMo's name is a combination of the initials GSM with G i(nternet) S M o(pen), and is a m-payment approach developed by Millicom (www.millicom.com). GiSMo allows account-based payments for Internet shopping, using a GSM phone to

verify the buyer's identity and authorize the transaction. Customers must first register and open a credit account (electronic wallet) on the GiSMo Web site, where they supply their mobile phone number and receive a use name and password. GiSMo can handle both micro-payments and macro-payments. Again, the pattern is the same, e.g.. the user gives his mobile phone number to the merchant an receives back an SMS with a transaction-specific PIN. The user reports the PIN back on the Web site or the merchant's POS, and the transaction is authorized. Both payer and merchant receive a notification, and the merchant notifies the GiSMo server that the goods have been delivered. Finally, the GiSMo customer can access at any time payment, billing, and shipping information on GiSMo servers. Again, this is a legacy system that uses the mobile phone as a complementary tool for extra security in a transaction. Millicom withdrew its product, and is working on a simpler alternative to GISMo.

25. HiPAAS: HiPAAS is a service offered by Upaid (www.upaid.net) that is based on proprietary payment processing software. The approach enables multiple parties such as banks, mobile operators, and merchants to connect to centralized payment authentication and service delivery centers to allow anywhere-to-anywhere handset-authorized payments. At the moment prepaid Top-UP services via SMS, ATM, Web, or POS are supported, and charging is done at the user's bank account or credit/debit card.

26. Investnet: MPS is a mobile payment system designed by Investnet (www.investnetinc.com). It is WAP-based and offers three different approaches with different levels of security. The charging is done on user's phone bill.

27. Macalla: The Macalla Mobile Payments Platform (www.macalla.com) is a MP solution that provides an extensive range of wallet and payment-related services orchestrating the interaction between a consumer, their preferred payment mechanism, a merchant, and payment processors.

28. Magex: Magex (www.magex.com) offers a managed payments platform that delivers a number of payment services, including mobile payment. They offer prepaid and postpaid accounts, direct fund transfer, and clearing services for easy integration. MasterCard International has selected (in June 2003) Magex's Managed Payments Platform as its chosen technology for its new European cross-border P2P payments service to be known as MasterCard MoneySend. The approach supports traditional and mobile channels, e.g. SMS, WAP, and IVR.

29. Meest (M-Token): Mobile e-commerce and eWork Secured Transactions (MEEST - www.meest-ist.org) is a European Union-financed project that focuses on e-commerce transactions via SIM, SMS, GPRS, and UMTS mobile technologies. MEEST's solution, m-Token, facilitates anonymous purchases of digital content from a mobile subscriber's prepaid account, or payments for goods at real-world stores, and also targets micropayments. M-Token users making micropayments from a prepaid account enter their phone number at an e-tailer, for SMS-based validation by the

operator, which settles with the merchant after the user has typed the validation code into the e-tailer's Web site.

30. Metax: Metax (www.metax.dk) offers petrol payment via mobile phones (a patented concept) in Denmark. The mobile phone is used as a replacement for a METAX credit card, therefore the customer still receives a monthly invoice from Metax even though a mobile phone is used. The user calls a free phone number and is invited to enter their PIN (provided by Metax), after which they can use the station's pump.

31. 33. MIDAS: MIDAS is a pilot MP service of NetCom (www.netcom.no) in Norway that is based on MoreMagic's payment transaction software MBroker. Credit cards (VISA/Eurocard) as well as the NetCom phone bill and mWallet, a server-side wallet comparable to a pre-paid card, were the supported payment methods.

32. Mint: Mint (www.mint.nu) is providing m-payment services in Sweden via their m-payment platform [31]. Mint can accommodate Internet, in-store, billboard payments, session, and person-to-person. Mint uses CLI (calling line identifier) for the identification of customers wishing to conduct a transaction and PIN codes for transaction authorization. The platform accepts DTMF as well as voice recognition. Other mobile interfaces include SMS and WAP. The scheme has attracted more than 11.000 users and 160 POS.

33. Mobiilraha: In Finland, operator Radiolinja and banks Nordea and Sampo will introduce a service that will enable payment for services by SMS. Users can download money between e 5 and e 400 to the mobile purse at Nordea's and Sampo's Internet banks. When paying, the user sends an SMS to the number provided by the retailer. The system checks whether there is enough money in the purse and sends an approval for the payment to the retailer. The retailer has to pay a commission for the system.

34. MobilBank: Mobilcom (www.mobilcom.de) and Landesbank Baden-Württemberg (LBBW - www.lbbw.de) joined forces and created MobilBank (www.mobilbank.de), which offers mobile payment services via WAP and SMS at the first stage, as well as more advanced services with the introduction of UMTS infrastructure. As the customers of the mobile payment service have a bank account with MobilBank, real-time checking of available funds is possible. A SIM toolkit allowed encryption of SMS. The project started in January 2001 but was stopped in May 2002 due to limited interest from the customer side (according to their press release).

35. MobileScape: Sprint (www.sprint.com) and Novatel Wireless (www.novatelwireless.com) are working on a wireless 3G payment processing system (MobileScape) for the enterprise market. MobileScape is envisioned as a platform that can be easily integrated as a wireless business process application and payment processing system for use by mobile workforces. MobileScape is equipped

with the MobileScape M2 handheld device, signature capture capabilities, an integrated printer, encryption, security, and a Web-based interface called POSware.

36. MobilMat: MobilMat (www.mobilmat.it) is a mobile payment service offered in Italy. The user is able to make Internet purchases and send money to other MobilMat users. The user is calling a toll-free number and interacts with a voice-based service via DTMF codes. After authorizing the transaction via a PIN, the results are immediately displayed on the mobile phone's screen (both on the recipient and the sender). The whole process takes only a few seconds to complete.

37. Mobilpay: Mobilpay (www.mobilpay.com) is a patented mobile payment service for VirtualPOS purchases in Austria. After the payer selects Mobilpay as the payment method, a one-time PIN is announced to the user's mobile phone via a voice service. By sending the PIN via SMS to the Mobilpay system the user authorizes the payment. Currently the activities of Mobilpay are, due to the global economic situation, "frozen" while management is searching for new investors.

38. Mobipay: Mobipay (www.mobipay.com) is a system introduced in Spain (but patented in 66 countries for future expansion) that can handle micro or macro payment transaction in a real and virtual POS as well as peer-to-peer. The system allows users to recharge their purchases with their bank-issued credit and debit cards, or with e-cash drawn from prepaid accounts. In a real POS payment the merchant enters in his terminal the code of the product to be purchased and the phone number of the consumer, or scans the barcode sticker given to the user with its registration on the Mobipay system. Then the consumer receives information on his screen about the purchased product and its price. With his PIN code he authorizes the transaction and the Mobipay system sends a confirmation message to both the user and the merchant. In Internet purchases the payer receives a reference number, which he enters on his phone together with his PIN. Both the payer and the merchant receive confirmation of the payment. Since November 2003 Mobipay has been available in cabs in several cities in Spain. The cab driver enters the amount of the fare and the customer's mobile phone number. The customer receives a message with the charge and he has simply to enter his credit card PIN to validate the transaction. It is worth mentioning what differentiates Mobipay. The Internet transactions are user-initiated (a virtual shop-generated reference number and the PIN are entered on the mobile phone) and no personal data are revealed (e.g. name, telephone number, etc.), therefore it is enhancing privacy and preventing problems such as misuse of the mobile phone number, e.g. via commercial SMS. Authentication is again provided via the SIM card; the PIN is sent over USSD (Unstructured Supplementary Services), which guarantees message delivery and communication is encrypted via a GSM-secure network (which is only effective on the Over the Air interface). A transactions are controlled by the Mobipay server and the processing is routed on the respective financial institution.

39. MoreMagic: MoreMagic (www.moremagic.com) was founded in 1997 and provides a mobile transaction platform that is an open, standards-based solution with a modular

generic architecture, that can accommodate mPayments, including prepaid and postpaid electronic wallet.

40. MoxMo: MoxMo (www.moxmo.com) is a mobile payment solution introduced in the Netherlands. The user is offered a mobile purse that is bound to a bank account. Transfers from mobile purse to mobile purse are possible.

41. MPark: mpark (www.mpark.ie) is a wireless parking payment system, launched in Dublin, Ireland. Customers are able to pay for on-street parking using their mobile phones. The user has to call a special number, follow the pre-recorded instructions, and input the requested information (on the mobile phone's keypad) in order to activate the ticketing machine. The authentication is based on the called ID (mobile telephone number) and charging is done on the user's credit card or phone bill.

42. M-Pay: M-Pay (www.m-pay.com) is a mobile payment system developed by Ultra (www.ultra.si) in Slovenia. The patented payment process is using voice to transfer the information necessary for the purchase. The user's identity is defined on a SIM card in the mobile phone and is further secured by entering a special PIN either on a phone or payment terminal. The payment terminal and payment center authenticate themselves with a digital signature based on an Elliptic Curve Cryptography (ECC). Data integrity is via digital signatures. End-to-end encryption is available for third parties, such as banks. The system has also been introduced in Croatia.

43. m-till: M-till (www.m-till.com) is a mobile phone micro-payment service aimed at publishers that want to sell digital content on an ad hoc basis in the UK. It is available on all four MNOs in the UK, and the charging is done on the phone bill. The customer selects the m-till method of payment by simply clicking on the m-till 'Buy' button, and then he receives an SMS with the code that grants access to the content he wishes to view.

44. Mzone: mzone is a complete mobile payment and service delivery solution from Network365 (www.network365.com) that addresses all the elements of the mobile Internet value chain from secure, personalized payments and identification to advanced messaging and optimization of content. Network365 was merged with iPIN in 2003 and offers a common product named ValistaPlus.

45. NewGenPay: NewGenPay (www.newgenpay.com) has taken the IBM micro-payment technology and developed it so that it can be used for a number of different payment methods. NewGenPay offers payment systems to a wide variety of payment service providers, including financial institutions, Telcos, and Internet service providers. The main product of NewGenPay is the Valuto System, which is easily customizable and can be used to build multiple payment applications, including wireless payments, person-to-person payments, and micropayments. NewGenPay microPayments implements W3C's common markup for micropayment per-fee-links specification

46. Nokia Payment Solution: Nokia (www.nokia.com) has been developing a MP solution (the Nokia Payment Solution) that is a server software product that enables mobile network operators and other service providers to position themselves as a payment mediator, offering consumers a method to pay, using a wide range of payment methods in a secured environment. Furthermore, Nokia has implemented an m-wallet in many of its phones, a password-protected area in the phone, where one can store personal information such as credit card numbers or loyalty card details.

47. Nokia's m-wallet "verified by VISA": In Sept 2003, VISA EU and Nokia agreed to enable mobile subscribers to make secure payments from their phone handsets by using Nokia's m-wallet application with "verified by VISA" authentication functions. The m-wallet from Nokia enables users to store personal data such as user names and passwords, VISA card details, and delivery addresses, on their phones. Since VISA cardholders can use the same password on the Internet and the mobile channels, VISA is effectively extending the transparency of its 3D-Secure protocol to mobile payments.

48. O-card: O-card is a e/m-payment solution from Orbiscom (www.orbiscom.com) that allows cardholders to shop online without having to transmit their actual card details over the Internet or mobile phones (WAP). A unique generated number (O-number) is used for each transaction. Customers can access the O-card application directly from their issuing bank's Web site and can communicate with their bank via the O-card every time they shop online. Mobile users can use the WAP.

49. Odysseo: Odysseo (www.odysseo.com) offered a virtual wallet that allowed safe purchases on the Internet on all merchant sites certified by Blue Line International (www.bluelineinternational.com). The purchases could be international in the currency of the user's choice, no matter which payment cards he had. The services were accessible via WAP and PDA. The pilot was discontinued in 2001.

50. Omnipay OnPhone: Omnipay OnPhone (www.omnipay.190.it) is an m-payment service that allows Omnitel customers owning a VISA card to pay for Internet purchases using their mobile phone. To make a payment the user must call a free phone number and follow the voice-based menu eventually authorizing the transaction by entering his PIN.

51. Orange/Mobilix Mobile Payment: Orange (www.orange.dk), in cooperation with PBS (www.pbs.dk), is offering a mobile payment service in Denmark (www.orangemobilbetaling. dk) also known in its first steps as "Mobilix" or "m-Pay." A credit/debit card is associated with a mobile phone number. In order to access the payment function of the mobile phone, the payer uses the individually assigned PIN code, which is attached to the SIM card of the mobile phone. When the user accepts a payment, a transaction certificate is created which makes sure that the information may not be changed later. The payment transaction itself takes less than 10 seconds.

52. Oskar: The Czech Republic operator Oskar (www.oskar.cz), in cooperation with Komercní Banka (www.kb.cz), provides pre- and post-paid subscribers with mpayment services. All payments are credited to the customer's account, who is informed of the transaction result immediately by SMS. The service is based on SIM Toolkit, and every transaction requires authorizations by both the provider and the partner bank.

53. Paiement CB sur mobile: This mobile payment service was offered France. The service uses a dual-slot phone, SIM Toolkit-based cards, and SMS messaging. The payer provides his mobile phone number to the merchant, an SMS notifies him about the transaction details, and then the smart card is inserted into the dual-slot phone and the PIN is typed. When the transaction is authorized by the bank, a confirmation message is sent by the bank via SMS to the payer, and the merchant also receives a payment confirmation.

54. pay@once: pay@once (http://www.siemens.com/payment/) is a real-time payment solution from Siemens that brings together the advantages of real-time charging, highly flexible payment logic as practiced in the prepaid card business, and extensive interfaces to existing payment methods and processes used in the financial services industry.

55. Paybox: Paybox (www.Paybox.net) was a mobile payment system launched in Germany in May 2000. It enabled payment via mobile phone for virtual and real world POS as well as peer to-peer payments between Paybox users at the national or international level (money streams are routed via Paybox - no direct payments are made). The user registers with Paybox, which provides him with a PIN to be used for authorization of future transactions. Existing phones can be and the system in general works as follows: The payer shares his phone number with the merchant who, via a free phone number, enters it into the Paybox system together with the price. Then Paybox calls the payer announcing to him via a voice-based system the merchant's name and the amount to be paid. Finally, the user authorizes this transaction with his Paybox PIN, and the Paybox system instructs Deutsche Bank to settle the transaction via "Lastschrifteinzugsverfahren," a sort of direct debit approach used in Germany that is cheaper to process than credit card payments. Paybox can also be used for purchases on the Internet. The only difference with the above-described procedure is that the transaction data is typed by the payer on the Web site. In Internet transactions the payer can also send money to the payee's bank account even if the later is not a Paybox customer. For mobile-tomobile (P2P) transactions the payer sends the money directly to a mobile number of another registered user, even in another country. Paybox as a service was offered in Germany in several real and virtual POS ranging from cabs to online transactions at ebay.de. Paybox acts as a neutral payment intermediary aiming at independence from telecom operators through a recognized brand and does not require any special mobile phone characteristics. However, the approach is not cost-effective (SMS and voice-based communication) and the PIN is transmitted via normal DTMF (Dual Tone Modulation Frequency) procedure. Paybox

announced in January 200 that it will restructure itself and therefore discontinue its service in all countries except Austria, where Paybox in 2004 reported having more than 100,000 customers. The problems that forced Paybox to this decision include the slow development of the m-payment market, the prolonged poor investment climate, and industry's unreadiness and lack of cooperation, particularly among banks and telecommunication providers, and the potential providers of a mass-market m-payment system. In July 2003 Paybox and British Telecom have formed an alliance to create a system for authentication and management of m-payment services, while efforts to expand in the Middle-East (initially in Kuwait and then the Persian Gulf region) are underway.

56. Pay-by-Phone (T-Pay): "Pay by phone" (formerly known as banko.mat) is a service offered by T-mobile (www. t-mobile.at) in Austria. The user has to register and get a PIN for transaction authorization. Services such as purchases of real-world goods, tickets, and lottery games are included. In Germany the same concept is marked under the T-Pay brand (www.t-pay.de) which is a mobile wallet that can also accommodate other payment instruments such as credit cards.

57. PaybyTel: PaybyTel (www.paybytel.net) is a mobile payment micro-billing solution for the Internet aggregated on the user's phone bill. When a user must pay something online, the Web site informs him of the premium number that he must call via mobile or a fixed line. The voice system gives the user the necessary access codes, which the user enters on the Web site of the merchant to complete the transaction.

58. Paydirect (Yahoo!): PayDirect (paydirect.yahoo.com) is a service that allows users to send and collect money online or over an Internet-enabled mobile phone by linking their credit/ debit cards or bank accounts to their secure Yahoo! PayDirect account at HSBC (www.hsbc.com).

59. Payitmobile: Payitmobile (www.payitmobile.de) was a mobile payment service launched as a pilot in 2001 in Germany. The system separated the payment process from the VirtualPOS, which did not receive the customer's mobile number, and used a procedure similar to Paybox, with the difference that the authorization was via SMS and not via voice. The system failed to make a breakthrough and was dropped by its partners.

60. Payline: Payline (www.payline.com) offers, among other services, mobile payment services. The mobile payment process is the same as in "paiement CB sur mobile," except that Payline manages the authorization process and the SMS authorization message.

61. PaymentWorks: Encorus (www.encorus.com) offers PaymentWorks, which is a secure, flexible, and scalable application software for enabling payment transactions from cellular phones, the Internet, WAP-enabled mobile devices, and PDAs. PaymentWorks Mobile can also be deployed at realworld Point-of-Sales facilities and

supports peer-to-peer transactions. Sprint (www.sprint.com) and eONE (www.eoneglobal.com) (mother company of Encorus) are working toward kick-starting general mobile payment initiatives in the U.S. The aim is to have a virtual wallet where several different payment methods can be supported, including credit/debit cards and stored value.

62. PayPal: PayPal (www.paypal.com) is a popular online payment service that was recently acquired by eBay(www.ebay.com). Via WAP-enabled phones the customer can use PayPal's wireless interface to accommodate MP. Payment recipients receive instant notification directly to their mobile phone. Peer-to-peer payments as well as international payments and bank transfers are possible. In march 2006, PayPal went mobile.

63. PayWare: PayWare is an ePayment product suite developed by Trinitech (www.trintech.com) that contains all the necessary elements associated with the transfer of monetary value from a buyer to a seller electronically, in the physical, virtual, and wireless environments.

64. Petrol Magna: In Slovenia, Petrol Magna and Mobitel users can activate a virtual Magna account, which lets them pay for petrol bought at petrol stations via their mobile phones. After filling up, a customer will be able to dial a special number, which will record the charge on the customer's Magna account, while a fee will be paid to Mobitel for the service.

65. Phonepaid: Phonepaid (www.phonepaid.com) provides mobile payment services to users who register with them. Users can send and receive money and pay for goods and services via regular GSM mobile phones. The service is SMSbased as well as voice-based, and the charging is done on a prepaid account. Payments can be made after putting funds in the account by credit/debit card (online), credit transfer, or check. Transactions are possible via the dial of a GSM phone number by using touch-tone (or voice) commands. The merchant's Phonepaid ID and product code also must be entered. When the transaction is completed, payer and payee receive an SMS notification.

66. PhotoPay: Fun communications (www.fun.de) has developed fun PhotoPay, an MP procedure for the Internet and virtualPOS, which requires a camera-enabled mobile phone. When the customer makes a payment, all the relevant data is displayed on a monitor. The customer then starts the PhotoPay application and takes a photograph of the screen contents, which is composed of special symbols or barcodes. The application decodes these contents, and lets the customer select the preferred method of payment (e.g. credit card, online bank transfer, or direct debit). The application stored on the mobile phone builds up a connection to the payment service provider's server and transmits the relevant data. The server receives the payment order from the fun PhotoPay application, carries it out (e.g. by sending the card details to the credit

card company, performing an online bank transfer or by submitting a direct debit order), and then notifies the customer and the shop about the status of the transaction.

67. Qpass: Qpass (www.qpass.com) offers a solution for generating and managing revenue from mobile commerce initiatives, e.g. the purchase of digital goods and services. Qpass is mostly a B2B solution that is used by several of its partners to provide m-payment services.

68. rePower: This MP procedure (www.MasterCardrePower.com), developed by MasterCard, is available in South Africa. Cardholders register with their participating financial institution in the U.S. or with their wireless carrier in South Africa, and provide their contact and payment information, their mobile phone number(s), and then select a rePower code or password for future authentication. The payment details are stored in a secure, password-protected account for them to access whenever they'd like to replenish their prepaid accounts using their registered debit or credit card.

69. Safetrader: Safetrader realizes a mobile payment B2B solution based on the Jalda which is, beyond an old Scandinavian word for pay, an Internet method payment system. EHTP (www.ehpt.com), which is now owned completely by Ericsson, has developed a system based on Jalda that is branded as Safetrader, and is a hub connecting content providers, a payment provider, and consumers. The players have a Jalda account hosted on the Safetrader server; when they receive money from the consumer the funds are transferred from the consumer's account to the content provider's account. The Jalda account can be loaded via money transfer from a bank account, a scratch card, or a credit card. The payer is billed by the payment provider, who deducts its fee and forwards the payment to the content provider (the final party responsible for balancing accounts). Consumers can be charged according to whichever parameter the service or product content provider chooses, e.g. elapsed time, quantities, items, mouse clicks, data files, searches, online gaming, streamed music, etc. Safetrader uses PKI, SSL/RSA for authentication, 3DES for symmetric encryption, and digital certificates (retrieved from the computer or a smartcard).

70. SecurePay: Pipeline (www.pipelinedata.com) is offering SecurePay (www.securepaywireless.com), which enables credit card connectivity via mobile phones (mobile POS) for merchants.

71. SmartMoney: This is a mobile payment method introduced by Smart Communications (www.smart.com.ph), the biggest GSM operator in the Philippines. A reloadable electronic cash card is linked to a cellular phone. The electronic wallet can be linked to its user's current account in participating banks, through mobile banking.

72. SmartPay (MobilHandel): SmartPay is an electronic payment system offered in Norway by Telenor (www. telenor.no) that uses PKI. MobilHandel

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(www.mobilhandel. no) is the first application of SmartPay. PKI is used for authentication of the payer and the signing of the payment, and the bank account, credit card, or mobile phone bill is charged. This solution requires the replacement of the SIM card with a new PKI-enabled card. As of February 2003 credit card-based mobile payments to all VISA holders are also possible.

73. Solo: Solo (solo.merita.fi) is an e-banking service also accessible via a WAP phone (since October 1999) that facilitates bank transfers, bill payments, investments in equity, mutual funds and bonds, electronically signed credit facilities, crossborder payments, and shopping at the Solo electronic mall. Crossborder payments are possible if the merchant participating in Solo has a Nordea bank account in every country. Mobile payment is done with the use of dual-chip phones.

74. Sonera: Sonera (www.sonera.com) has launched a mobile payment system that can be used with the existing generation of telephones (2G) and can be applied in attended and unattended POS. The payment can be done in three different variations: a) payment via a credit card; b) payment via direct debit; and c) by calling a premium rate number. In the latter case each individual product price is associated with a number and the charge is on the user's MNO bill or another account if a prefix is used (for Finland 152) that allows account selection. In any case, the user must sign a contract with Sonera and register the payment method(s), e.g. credit card, direct credit. In the case of an MNO charge (mobile phone bill) the existing MNO registration is used and the amounts are aggregated on that bill. The latest mobile payment service launched by Sonera is named "Shopper" (www.sonera.net/shopper) and is available in the metropolitan area only. The customer sends the search word MAKSU followed by his personal security code to number 13130, and he receives a reply text message with a six-digit payment code that he shows to the cashier. The customer can make text message inquiries about recent payments and account transactions. It is worth mentioning that Sonera (now merged with Telia (www.teliasonera.com)) has been developing mobile payment-related solutions since the early 1990s.

75. Sonofon mBanking: Sonofon (www.sonofon.dk) is providing a mBanking service to its customers. A Web browser stored on the modified SIM card is used. The customers can check balances, trade stocks, pay bills, and make fund transfers (among the participating banks). The service uses end-toend encryption based on the 3DES between the SIM Card and the banking data centre (www.bankdata.dk). Virtual POS support is also planned.

76. SPA: Secure Payment Application (SPA) [34] is an issuer-based authentication mechanism that uses MasterCard's (www.MasterCardintl.com) Universal Cardholder Authentication Field (UCAF) infrastructure. UCAF is a multipurpose data transport mechanism implemented by merchants and acquirers for collecting authentication information generated by issuers and cardholders. Once collected, this information is

communicated to the issuer in the payment authorization request and provides evidence that the transaction was originated by a legitimate cardholder. UCAF supports a variety of issuer security and authentication approaches including SPA, smartcards, and more. SPA is a multi-platform service, e.g.. it accommodates payment transactions conducted via smartcards, PDAs, mobile phones, and other wireless devices. SPA makes use of public key infrastructure (PKI) and is designed to reduce the incidence of chargebacks in which the account holder disputes having authorized a transaction.

77. Street Cash: StreetCash (www.streetcash.de) is a m-payment system that uses SMS as the basis of communication. The merchant sends an SMS with the payer's mobile phone number and transaction details to Streetcash, which via SMS again notifies the payer. The authorization of the transaction is done by sending back the PIN code via SMS to Streetcash. In Internet transactions the procedure is the same, with the difference that the payer enters his mobile phone number on the Web site or WAP page. The user must be registered with StreetCash and the amount is charged on a bank account or a credit card. StreetCash makes it possible to pay for tickets via SMS and receive the paid tickets on the mobile (again in the form of SMS). For a non-StreetCash user who receives an SMS requesting a payment confirmation, Inatec (www.inatec.com), in cooperation with Paysafecard (www.paysafecard.com), provides a mobile prepaid anonymous solution by charging the prepaid account. In the latter case the user authorizes the transaction with his Paysafecard numeric code. The solution is insecure, not cost-effective, and not reliable, as it is based on SMS.

78. Swisscom Sicap: Swisscom (www.swisscom-mobile.ch), in cooperation with Sicap (www.sicap.com), since August 2002 has been offering to its customers in Switzerland the capability of purchasing beverages from vending machines. The payer has only to dial the special USSD number written on each machine. The purchased items are paid either by charging the payer's bank account or the MNO's bill. The USSD method was selected because it is faster than SMS. Swisscom uses a similar service ("Quick and More") with Consultas in order to allow customers to pay for online articles via their phone. Similar services have existed for several years now in other European Nordic countries allowing mobile phone users to purchase golf balls, beverages, etc. from vending machines, or fast food by dialing a phone number or a USSD command on the product.

79. Telemoney: In this MP service (www.telemoneyworld.com) the user must register and select a preferred payment method such as credit card, debit card, direct debit to bank account, or stored value. With Internet payments the user must provide his telephone number, and confirm via PIN the transaction after a system-generated call. A confirmation, via voice on the mobile and on the screen of the computer, is presented, while a receipt is also emailed to the user. In other cases, e.g. TeleCab, the user must call a number and manually enter the cab driver's Telemoney ID and amount of fare to be paid. Other services such as Telepay and TeleParking have similar concepts.

80. TELEPAY: Telepay stands for the "Telepayment system for Multimodal Transport Services using Portable Phones," and is a European Union project (IST-2000-28269). The TELEPAY project is developing a payment system that allows transport service payments using mobile devices (for example, public transport, tolling for motorways, etc.). Virtual "e-tickets" in mobile phones and e-tolling using SMS, WAP, and short-range communication technologies are the project's goals.

81. Telia PayIT: PayIT was a mobile payment service of Telia (www.telia.se) in Sweden. This service used the Jalda platform offering micropayments for Internet purchases. The digital goods were billed either on a phone bill or in a prepaid account.

82. Trivnet: Trivnet (www.trivnet.com) introduced in 2001 a pilot in which users could use their mobile phones to surf and purchase products via WAP. The charging was done in the user's mobile phone bill.

83. Turkcell: Turkcell (www.turkcell.com.tr), which has a customer base of approximately 15.7 million postpaid and prepaid users, offers a credit card-based mobile payment service by teaming with Yapi Kredi bank (www.ykb.com). Subscribers with a valid bank account send a string of USSD-based encrypted code, including the code of the bank, and the product details, to the cash register. Then the subscriber receives a secure confirmation code, which the merchant enters into his system to conclude the payment. All initiated mobile payments are charged to a subscriber's predefined Yapi Kredi credit card, and are free to subscribers, apart from the text message for the payment.

84. VISA Movíl: VISA (www.VISA.es) in Spain offers a mobile payment system where the charge is done via VISA cards. The mobile phone number is associated with a VISA card. In Internet purchases, the user provides his mobile phone number, and in real POS the merchant enters the payer's phone number via an ad hoc terminal. VISAMovil calls back the user, who authorizes the transaction with his PIN. On May 31, 2001, Caixa Movil joined the scheme, therefore VISAmovil substituted the former Caixamovil standalone solution. It is worth mentioning that the system is less sophisticated but also less expensive than Mobipay.

85. Vodafone's m-pay bill: Vodafone offers to its customers a microbilling solution (MP bill.vodafone.co.uk) whereby online purchases are charged on the mobile phone bill. In order for the service to be used, the user must register and choose a user name, a password, and a 4-digit PIN. The solution uses iPIN's (www.ipin.com) e-Payment Platform. The XML-based user interface gives consumers a consistent look and feel when making purchases in different environments. The charging is done on the user's monthly postpaid account or in real-time on the prepaid account. The user can pay online by entering his login/password or via WAP by simply entering his PIN.

86. WAAAP Pag: This (www.waaap.com.br) is a mobile payment service offered in Brazil. The users must register and the purchases made are debited to the user's MasterCard. The users enter the merchant's ID, the amount of money, and their PIN code in order to authorize the payment. The service uses WAP and a platform developed by EverSystems (www.eversystems.com.br).

87. W-HA: W-HA (www.w-ha.com) is a microbilling solution based on iPIN's (www.ipin.com) platform. Goods can be purchased, and the charges are made on the MNO bill or in the credit/debit card (if the user has an iPIN account).

88. YW8: "Why Wait?" (YW8 - www.yw8.com.sg) is an m-payment service that was commercially launched in February 2003 in Singapore. The user links his virtual account with VISA or an eNETS VCard (www.nets.com.sg) stored value account and the payments are charged there. The service is based on SMS and WAP. The service extends the exiting Bankpas Web service for mobile users.