Classifying Payment Instruments: A Matryoshka Approach (*)

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Abstract: The payments market is a dynamic market. Novel payment instruments are being launched at a fast clip. Unfortunately, a classification that adequately distinguishes all possible payment instruments by their most relevant characteristics is missing in the literature. In this paper a classification system is introduced that – just like a matryoshka doll – consists of multiple nested layers. The classification has five layers, comprising the type of money, the core payment mechanism, the channels and networks involved, the form factor and authentication device used, and, ultimately, seven generic payment methods. The idea is that a specific combination of features from each of the five layers ultimately defines a real-life payment instrument. Besides its comprehensiveness, the added value of the classification is that it reveals the true nature of a payment instrument, which on closer scrutiny may not be all that novel.

Key words: Payment instruments, classification, money, technology.

In recent years, a whole range of innovative payment instruments[1] have been developed for usage on the Internet and/or through mobile phones. And there is no reason to expect that this activity will subside quickly – on the contrary. Pundits are convinced that mobile payments (m-payments) will become all the rage. Moreover, in Europe, new players are expected to enter the market because of the new legal framework provided by the Payment Services Directive (PSD) (EC, 2009).

(*) Acknowledgements: We are indebted to Remco Boer (Innopay), David Bounie (Paris Telecom), Markus Breitschaft (University of Regensburg), Jakub Gorka (University of Warsaw), Malte Krüger (Fachhochschule Frankfurt, PaySys Consultancy) and Wiebe Ruttenberg (European Central Bank) for comments on earlier versions of this paper. Special thanks go to Marc Temmerman (Visa Europe) for particularly perceptive comments. The views expressed in this paper do not necessarily reflect those of the European Central Bank.

1 A payment instrument is defined as 'any instrument enabling the holder/user to transfer funds' (ECB, 2009).

Given this level of activity, consumers, merchants and other interested parties (regulators, banks, etc.) might encounter difficulties in obtaining a clear overview, in determining the true nature of a payment instrument, and in mapping the competition between banks and non-banks. Hence, a comprehensive classification might be a helpful tool. This paper introduces such a classification. All possible payment settings are considered, but the focus is on retail payments and the process of paying (as opposed to loading an account, or withdrawing cash at an ATM). Also, the examples tend to concentrate on payment instruments for e/m-commerce, as these are the most novel.

Just like a matryoshka doll, the classification consists of multiple nested layers. The smallest 'doll' embodies the type of money used. The next layer defines the core payment mechanism. Layers three and four comprise, respectively, the channels and networks involved, and the form factor and authentication device used. Finally, the fifth layer contains seven generic payment methods. The idea behind the approach is that a specific combination of features from each of the five layers ultimately defines a concrete, real-life payment instrument. Special cases such as collection/billing services are treated in a sixth, transcending layer, that also (partly) comprises value-added services (VAS).

The remainder of this paper is structured as follows. The next Section gives a brief overview of classification approaches encountered in the literature, and points out their main advantages and drawbacks. The following Section introduces the classification model, which is applied in the last Section.

■ Existing classification approaches

As Table 1 shows, existing classifications of payment instruments use (and often combine) a whole range of criteria. However, by and large, two groups of authors can be discerned: those who focus on generations and characteristics of payment instruments, respectively.

BÖHLE (2002), HARTMANN (2006) and the ECB (2002) are in a first group that simply distinguishes generations of electronic payment instruments. The ECB (2002), for example, discerns e-payment initiatives based on traditional payment instruments from new payment services that use information and telecommunication technologies that were previously

not available for such purposes. This approach has the benefit of transparency, but the absence of a further classification within the two cohorts is a weakness.

Table 1 - Criteria used in classifying payment instruments

- Generations of payment instruments: first movers *vs*. more developed, traditional *vs*. innovative/developed for the Internet
- Type of account: hardware *vs*. software, token *vs*. account, server *vs*. client-based
- Moment in time of settlement from the payer's perspective: pre-paid, pay-now, post-paid
- Type of intermediary involved in the settlement: bank, credit card company, telephone company, software company, etc.
- Coverage: national *vs*. international
- Usage context: e/m-commerce, POS, (un)conditional, etc.
- Payment size: micro *vs*. macro
- Risk: guaranteed *vs*. non-guaranteed

A second, more populous cluster of authors base their classifications on payment instrument characteristics. Two typical examples are considered here, both of which consider the whole span of (e-)payment instruments[2]. A further two classifications are mentioned in the next Section, because they proved to be a source of inspiration for the approach of this paper.

To start with, ABRAZHEVICH (2004) defines two main categories of e-payments: electronic cash (or token-based) systems and credit-debit (or account-based) systems. This first-level dichotomy is based on the form of money involved. In ABRAZHEVICH's view, electronic cash entails the exchange of electronic tokens that represent value (comparable to the use of conventional cash), whereas in account-based systems, money is kept on records in bank accounts. ABRAZHEVICH then subdivides electronic cash into smart card *vs*. online (i.e., Internet) cash systems, and splits up account-based systems in generic, specialised, and credit and debit systems. A problem is that the borders between these subcategories are hazy. For instance, in ABRAZHEVICH's terminology, PayPal is a generic system. However, PayPal makes use of e-mail addresses, as do the 'specialised' systems in this classification. Another drawback is that different criteria are used to subdivide the two main categories.

STROBORN *et al*. (2004) first sort payment instruments by the point in time when the payer's account is charged, which yields the (familiar) distinction between pre-paid, pay-now and post-paid systems. These

[2] There are also classifications with a more limited coverage: YU *et al.* (2002) distinguish four types of Internet payment systems, PARHONYI *et al.* (2006) focus on micro-payment instruments and KREYER *et al.* (2002) design a morphological box to classify mobile payments.

categories are then further subdivided: pre-paid into hardware *vs*. software based, pay-now into Cash On Delivery (COD), debit entry and m-payments, and post-paid into credit card, invoice and collection/billing. A problem with this approach is that m-payments – which STROBORN *et al*. classify under 'pay-now' – can also be post-paid, for instance when the amount due is added to the customer's telephone bill. Or they can be pre-paid, for that matter. Another point of criticism is that, on the second level, no real motives for classification can be discerned, apart from maybe certain technological aspects.

To sum up, a quick roundup of the literature shows that it is not easy to come up with a mutually exclusive classification of the multitude of payment instruments currently available. The next Section presents a classification that is of the characteristics- rather than the generations-type.

■ The matryoshka approach

In designing the classification, the starting point was the model developed by the Institute for Banking Innovation at the University of Regensburg (IBI, 2006) and presented by STAHL (2006, p. 7); see Figure 1. This model is improved by incorporating dimensions exploited by other authors.

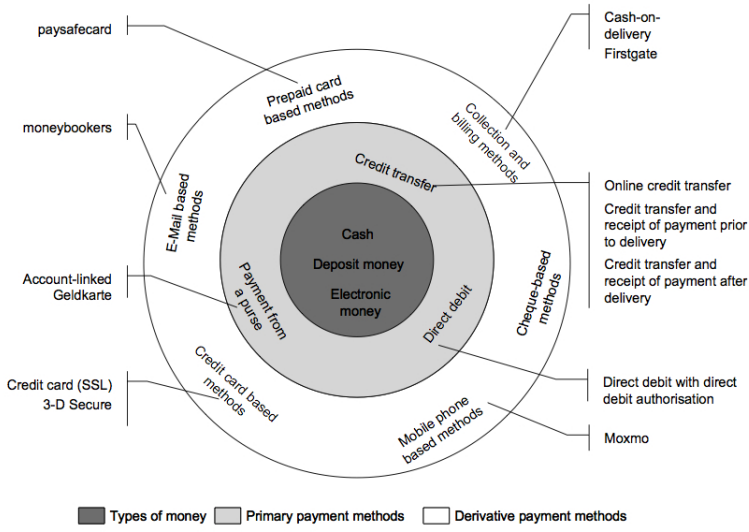
At the core of the classification, as with the IBI, several types of money are distinguished; see Figure 2. Currency is defined as consisting of banknotes and coins issued by central banks. Giral money comprises overnight deposits at financial institutions – which, in the European Union (EU), may also comprise so-called payment institutions as introduced in the PSD[3]. E-money is pre-paid monetary value stored on an electronic device (a card, a hard disk, or a server)[4]. Finally, unlike the IBI, private currency is included in the first layer because it is a (privately issued) unit of account, a means of payment, and a store of value (ECB, 2009). Private currency can be paper-based in the form of banknotes (e.g. Local Exchange Trading

[3] The PSD (2007/64/EC) entitles payment institutions to offer a number of restricted payment services, but they are not allowed to issue e-money (ECB, 2008, p. 5).

[4] In the EU, the Electronic Money Directive (EMD) of October 27, 2000 defines electronic money as 'a claim on the issuer that is (i) stored on an electronic device; (ii) issued on receipt of funds of an amount not less in value than the monetary value issued and; (iii) accepted as means of payment by undertakings other than the issuer' (KRUEGER, 2002, p. 241).

Systems such as Ithaca Hours) or electronic (e.g. Linden Dollars in the 'Second Life' virtual world). The electronic form of private currency on the one hand and e-money on the other may look similar. However, private currency also has its own unit of account, whereas e-money is denominated in an existing central bank-issued currency. Loyalty points (such as air-miles) can also be thought of as a form of private currency.

Figure 1 - The IBI's classification approach (IBI, 2006, p. 48)



Note that in defining the types of money, the approach is as regulation-neutral as possible to avoid that a given payment instrument might end up in a different category depending on the country considered. The definition of e-money, for example, differs between the EU and the United States (US), and in the EU it can only be issued by ELMIs[5]. Moreover, an approach that focuses on governance would also not be time-consistent. In the EU, pre-paid balances held by mobile network operators that can be used, for example, to buy ring tones and music currently do not fall under the EMD. However, the revised EMD of April 2009, which should be transposed into

[5] The Act on the Supervision of the Credit System defines an ELMI as 'an institution that is not the regular credit-institution (under article 1.1a1 in the supervision law) but that receives funds in exchange for which e-money is issued that can be spent with others than the organisation or institution that has issued the e-money' (ECB, 2003, p. 8).

national law by 2011 at the latest[6], opens up the ELMI statute for companies engaged in non-payment activities, such as telecommunications. Thus, operational (rather than legal) definitions are developed that focus on the way in which instruments function. As a result, this paper's understanding of e-money, for example, is broader than the EU legal definition. Specifically, e-money issued by small issuers that operate under a waiver from the EMDs does appear in the category 'e-money'. In this way, the pre-paid aspect of e-money is emphasised; that is, the fact that it is 'earmarked' for spending within a specific scheme – unlike money in a current account, which can be mobilised via multiple access products[7]. This said, this approach is not completely regulation-free, as the concepts 'banks' and 'central banks' are just about impossible to avoid. However, for these concepts the inter-country differences in definition would appear to be smaller.

In a second layer in Figure 2, the focus is on the core payment mechanism and – in particular – the settlement method. Where settlement is concerned, one could, in principle, concentrate on the moment in time at which the payer's account is debited, previously referred to as pre-paid, pay-now, post-paid[8]. However, as was pointed out above, this criterion lacks discriminatory power. The IBI (2006) distinguishes three ways of disposing of money: through payment from a purse, via a credit transfer and via a direct debit; see their second layer in Figure 1. In doing so, they merge two entirely different payment means such as cash and an e-purse under one denomination (payment from a purse). This is rather awkward and requires a distinction between 'classic' and 'electronic' in the outer layer of Figure 1. A second weakness is that the second layer mixes up two criteria: carrier of money (purse) and money transfer mechanism (credit transfer and direct debit). This paper's second-layer approach is more generic and, in this way, pushes back part of the distinction between, for example, cash and e-purse to a higher layer. Concretely, a distinction is made between push and pull systems, because, at the core, all payment instruments can be assimilated with one of these two mechanisms. PEIRO *et al*. (1998) also makes this distinction, but only for what they call 'indirect' payment models (whether there is a no direct information flow between payer and payee). This also works for 'direct', cash- and cheque-like models.

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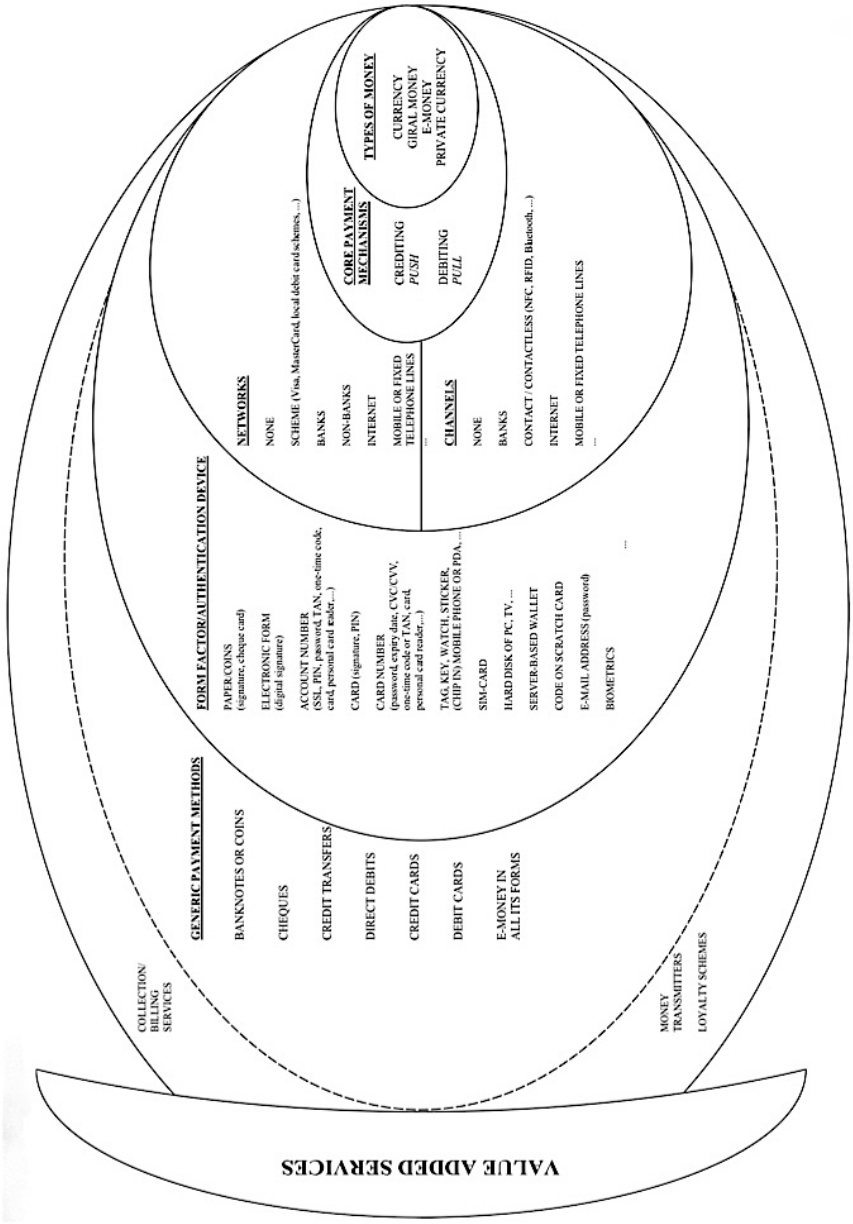
6 See http://www.hm-treasury.gov.uk/d/consult_emd_200109.pdf

7 There is a grey zone here, namely so-called pre-authorised debits.

8 The following authors (partially) base their classification on this criterion: KREYER *et al*. (2002), YU *et al*. (2002), Cap Gemini (2003), STROBORN *et al*. (2004), LYCKLAMA *et al*. (2006), and PARHONYI *et al.* (2006).

Figure 2 - Our classification model



In push models, the payer initiates the payment and sends an instruction for funds transfer to his financial institution (the issuer), who transmits the funds to the acquirer, who in turn notifies the payee of the reception of funds.

In the pull model, the initiative for the payment originates from the payee, who sends a request for funds transfer to his financial institution (the acquirer), who then gets the funds from the payer's issuing bank. In the end, the payer receives a notification from his financial institution about the transfer (e.g. an account statement on a direct debit).

As can be seen in Figure 2, the push/pull dichotomy relates to two generic payment mechanisms (namely debiting and crediting) that describe the transactions taking place in the accounts of the parties involved – which, crucially, may be kept by a payment service provider (PSP[9]) rather than a bank. The accounts may even not be directly perceivable by the transacting parties, but may be shadow accounts where crediting and debiting takes place 'behind the scenes'; *cf.* so-called accountable e-purses such as Proton and Visa Cash. Even payment schemes with no accounts whatsoever (e.g. Mondex, eCash) are tractable in this way. In such cases, monetary value is represented by real electronic coins (as opposed to a mere counter), and the coins are transferred from one physical carrier to another (e.g. from the card of the consumer to a chip in the merchant terminal). Hence, immediate crediting takes place (as with a cash payment), and this can be thought of as a push mechanism.

Recapitulating, two layers of the classification are explained. The first layer identifies four types of money. The second layer identifies the core payment mechanisms; that is, it concentrates on the (direction of) flows of information and/or money, and distinguishes two types, depending on which party – payer/payee or bank of payer/bank of payee – takes the initiative in settling the claim. Moving outward in the onion-like structure, layer 3 tries to capture the fact that most instruments rely on channels/networks through which the payment is initiated, processed (and possibly also cleared). More specifically, payment-related information is transmitted between different nodes and/or parties in the payment process. A complication is that the successive stages in this process often make use of different networks. For example, different networks (and associated technologies) can be used for the transmission of messages between authentication device and merchant terminal, and between terminal and central computer system. This is why layer 3 is split in two, and the term 'channel' is used to designate the technology used for device-terminal communication (that is, the first stage),

[9] A PSP is 'a company that offers service in the area of payments. These services consist of, for example, various payment modalities, Electronic Bill Presentment and escrow services. A PSP acts as intermediary between buyer and seller' (Innopay, 2008, p. 108).

and 'network' to designate the (most important) infrastructure that is used in the later stages[10]. Where the latter is concerned, practitioners often use the term 'tracks'. Crucially, the 'networks' are not to be confused with the 'scheme rules', the set of rules and standards that have to be followed by the users of the payment scheme. In today's payments world, the scheme rules under which a transaction takes place and the tracks via which it is processed are increasingly separate. Visa transactions, for example, do no longer need to go via VisaNet (Visa's own network), but can be processed bilaterally between two banks, or via another network (e.g. Equens) or chain of networks[11]. This is precisely the reason why the paper does not concentrate on the scheme rules in the second half of layer 3, but rather on the infrastructure. Compared to the first half of layer 3, the second half is less technological and more institutional in nature, in that it focuses more on ownership of the infrastructure.

Table 2 - Possible channels/networks used in a payment transaction – some examples

Payment transaction	*Channel*	*Network*
Credit transfer at self-service machine in bank branch	Contact	Bank
Credit card payment at self-service machine in railway station	Contact	Scheme or non-bank
Contactless payment with tag in supermarket	RFID or NFC	Scheme
P2P payment with cell phone to a friend	Bluetooth	If mobile operator: non-bank
Pay for parking space by cell phone (SMS)	Mobile telephone lines	If mobile operator: non-bank

Given these definitions, (technical) channels are thus used to initiate the transaction and can be for instance contact[12], contactless (NFC, RFID, Bluetooth), Internet and mobile or fixed telephone lines. Examples of (institutional) networks, on the other hand, include scheme networks such as Visa and MasterCard and local debit card schemes, bank-owned networks and networks owned by non-banks. Note that inter-bank clearing via

10 The problem is only partly solved because there may be more than two stages, each with their own infrastructure – possibly even a mix of open and proprietary networks (such as the Internet and telephone lines). An alternative would have been to introduce additional layers, but Figure 2 is already complex enough as it is.

11 In some cases, the scheme does not even own a physical network, and only sets the rules – Currence in the Netherlands and its 'iDEAL' online banking scheme being an example.

12 By 'contact' is meant a physical connection between the payment actors or devices, e.g. a direct card-machine interaction.

Automated Clearing Houses (ACHs) for retail payments is outside the scope of this paper, even though in some cases part of the clearing can be done in the networks that are listed in layer 3 of Figure 2. Table 2 illustrates, for a number of cases, how different channels/networks can be used in one and the same transaction.

Some further clarification might be needed regarding the terms 'scheme network' and 'non-bank'. Scheme networks are proprietary networks in which multiple players entrust the operation and governance of a common infrastructure to a separate entity, which may be members-owned. Examples are the Visa and MasterCard schemes, but also national debit card schemes such as BC/MC in Belgium (Innopay, 2008, p. 16). Simpay (now defunct) would have been an example in the mobile telecom world. Conversely, a network is labelled as simply being 'non-bank' when it is owned by a single non-bank player (such as a private processor or a mobile operator).

Turning to layer 4, carriers or form factors can store the money and/or can play a role in the authentication process. In many cases separate authentication devices or procedures are used, but in the case of bearer instruments (e.g. cash and e-purses without centrally held accounts), as well as for accountable purses, there is no need for authentication[13]. Note that the term 'form factor' over 'carrier' is preferred because the first is more general: most payment instruments do not carry money, but are simple access products. Authentication devices can be manifold; see the last Section. In the case of m-payments (and leaving aside scenarios in which a payment card would be inserted into the phone), the main options are: the payment application resides on a separate (bank-owned) chip, it is loaded onto the SIM card (owned by the mobile network operator), or external form factors can be used like stickers with a chip that are attached to the cover of the phone (and that can in some cases be read by the mobile device).

Layer 5 distinguishes seven generic payment methods, namely banknotes or coins, cheques, credit transfers, direct debits, credit cards, debit cards and e-money (in all its forms). Innopay (2009, p. 96) defines a payment method as 'a generic way in which a payment is carried out', for instance by credit card. 'When a payment method is not generic but specific, it is called a payment product' (or, in the terminology of the paper, a payment instrument). The idea is that all payment instruments encountered in reality

[13] A qualification is that higher-denomination banknotes may be checked by means of a counterfeit currency detector.

correspond with one of the seven generic payment methods. In the lower layers, these payment methods can be combined with various form factors, authentication devices, channels and networks. And ultimately the instruments use a push or a pull mechanism, as well as a specific type of money.

A final note is that three special cases are treated in a transcending (sixth) layer: money transmitters, loyalty schemes and collection/billing services (see the last section for more details). In this layer, VAS are also (partly) incorporated. For this, the concept of 'electronic products' (e-products) introduced by the ECB (2008) is built upon. An e-product is essentially a bundle comprising the e-payment as well as VAS. The e-payment includes the electronic initiation, processing and settlement of funds; VAS, for their part, are fully electronic retail services, based on a paper-free document flow offered to customers before or after the settlement of funds. However, as is explained below, determining exactly where an intermediary should be placed can be quite tricky. PSPs and mobile operators sometimes do not immediately transfer the funds and are thus in the e-payment. In other cases, they simply provide services surrounding the payment. This is visualised by the partial overlap between VAS and layer 6.

■ How to use the classification?

As explained, the core idea behind the approach is that a specific combination of features from nested layers ultimately defines a payment instrument. This Section explains how the matryoshka dolls can be assembled. A number of typical examples is analysed for each of the generic payment methods discerned in layer 5, as well as for the three special cases in layer 6. For convenience, all examples are numbered and carry the prefix 'ex' (see Table 3).

Banknotes or coins

In this category, payments are made by means of banknotes or coins, either in paper or electronic form. The settlement takes immediate effect; that is, there is finality and the money is instantly available for the payer's purposes. The currency units may be central bank-issued or privately issued (L 1). In point of sales (POS) transactions, the payer simply hands over a

banknote to the payee (ex 1). This is a push mechanism (L 2), and no authentication device is required because money and payment instrument coincide (L 4). No channel is involved and central banks together with commercial banks handle the network (L 3). The picture is different for payments with, say, Linden dollars (ex 2). Here, the Internet is used for the transmission of messages between payer and payee, while the network is managed by a non-bank (L 3). The form factor of this private currency is a server-based wallet, which is accessible via the user's Second Life first and last name in combination with a password (L 4).

Table 3 - How combinations of layers define real-life payment instruments

N°	Payment Instrument	L 5	L 4	L 3	L 2	L 1
		Generic payment method	Form factor – Authentication device	Channel – Network	Mechanism	Type of money
1. BANKNOTES/COINS						
1	Banknote of € 50 paid with @ POS	Banknotes or coins	Paper – None	None – Central bank	Push	Currency
2	Linden dollars	Banknotes or coins	Server-based wallet – Second Life first and last name and password	Internet – Non-bank	Push	Private currency
2. CHEQUES						
3	Paper cheque	Cheques	Paper – Signature and cheque card	None – Bank or scheme	Pull	Giral money
4	PayByCheck	Cheques	Electronic form – SSL-secured digital signature	Internet – Non-bank	Pull	Giral money
3. CREDIT TRANSFERS						
5	Paper credit transfer	Credit transfers	Paper – Bank account number and signature	None – Bank or scheme	Push	Giral money
6	Credit transfer via iDEAL	Credit transfers	Bank account number – One-time code or TAN, card, personal card reader and PIN-code	Internet – Scheme	Push	Giral money
4. DIRECT DEBITS						
7	Direct debit via the KBC bank	Direct debits	Bank account-number – None	Banks – Bank or scheme	Pull	Giral money
5. CREDIT CARDS						
8	Visa credit card used at POS	Credit cards	Card or other device – PIN-code or signature or none	Contact or contactless – VisaNet scheme or non-bank	Pull	Giral money
9	MasterCard	Credit (or debit)	Card or other device	RFID – MC	Pull	Giral money

	PayPass	cards	– None	scheme or non-bank		
6. DEBIT CARDS						
10	Internet payment with BC/MC debit card	Debit cards	Card number – One-time code, personal card reader, card and PIN-code	Internet – BC/MC scheme	Pull	Giral money
7. E-MONEY						
11	PayPal	E-money, debit or credit cards	E-mail address – Password (+ for mobile telephone: six-digit security code via SMS)	Internet or mobile telephone lines – Bank in the EU, non-bank elsewhere	Push or pull	E-money or giral money
12	eCash ✞	E-money	Hard disk – The coin's serial number	Internet – Scheme	Push	E-money
13	Proton	E-money	Chip on debit card – None	Contact – Scheme (Atos Worldline)	Push	E-money
14	Octopus	E-money	Card, watch, sticker, mobile device – None	Contactless – Scheme (public transport companies)	Push	E-money
15	Wallie-card	E-money	Server-based e-wallet – PIN	Internet – Non-bank (ELMI in EU context)	Push	E-money
16	Dexit	E-money	Tag – None	RFID – Non-bank	Push	E-money
17	Tunz	E-money	Server-based e-wallet – PIN-code	Mobile telephone lines or Internet – Non-bank (ELMI in EU context)	Push	E-money
8. LOYALTY SCHEMES						
18	Lufthansa's 'Miles and More'		Miles and More collectors card – 5-digit code	Depends – Non-bank	Push	Private currency
9. MONEY TRANSMITTERS						
19	Western Union	Banknotes or coins, credit or debit card	Depends – Depends	Internet, (mobile) telephone lines, none, contact – Non-bank	Push or pull	Banknotes or coins, giral money or e-money
10. COLLECTION/BILLING SERVICES						
20	Firstgate's ClickandBuy	Credit transfers, credit cards, e-money, ...	User name – Password	Internet – Non-bank	Push or pull	Giral money or e-money

Cheques

This category comprises paper as well as electronic cheques, used in a real-world and Internet setting, respectively; see ex 3 and 4. The type of money involved is giral money (L 1) and cheques always rely on pull mechanisms (L 2)[14]. For paper cheques (ex 3), no specific technology is required for transmission to the payee – hence the 'none' in the first part of layer 3. Once the payee presents the cheque to his/her bank, typically bank-owned networks enter into play. However, the rules can also be determined by a scheme, as was the case with the Eurocheque, for example. Authentication takes place by means of a signature and (possibly) a cheque card (L 4). Electronic cheque scheme PayByCheck in the US (ex 4) relies on the Internet for communication between consumer and merchant, while the network is operated by a non-bank (L 3). The form factor is an electronic form that is authorised by means of an SSL-secured digital signature (L 4).

Credit transfers

Credit transfers rely on giral money (L 1), and the funds are pushed from the payer's to the payee's bank account (L 2). The channel that is used can simply be 'none' when the payer submits a paper credit transfer at the teller (ex 5), 'contact' when the payer enters a transfer at an ATM, telephone lines in the case of phone banking, and 'Internet' for online banking (ex 6). Note that online banking may involve single-bank or multi-bank platforms. iDEAL in the Netherlands is an example of the latter (ex 6). For so-called 'on-us' transfers, the network will be the bank's own network. Interbank transfers require clearing and the network will thus typically be a (bank-owned) scheme[15]. For paper-based credit transfers, the authentication device is an account number and signature (ex 5). For online banking, the account number is the 'form factor', and authentication can, for example, be performed by means of a one-time code or Transaction Authentication Number (TAN) – for which a card, a personal card reader and a PIN-code are required (ex 6).

14 Some ambiguity might exist as to whether a cheque is a push or a pull instrument. Although the cheque is passed on (i.e. 'pushed') from the payer to the payee, only the payee decides when to change (i.e. 'pull') his claim either into cash or into account money (by ordering his bank to 'pull' the amount on his behalf).

15 In some countries, the central bank may also be involved. Belgium is an example.

Direct debits

The matryoshka dolls for direct debits practically match those for credit transfers. There is one crucial difference, in that with direct debits the payee's bank is authorised to pull the funds from the payer's bank account, making it a debiting (pull) mechanism (L 2); see Ex 7. There is no need for authentication from the part of the payer since the payment is pre-authorised (L 4).

Credit cards

Credit cards can be used for real-world as well as Internet transactions, and ultimately rely on giral money (L 1). Credit card payments are debit pull transactions (L 2), in which the cardholder authorises the credit card company to debit his/her account. In a first step, the merchant terminal reads the card content in order to secure the transaction and obtain the required transaction routing information. Next, this information is transferred from the merchant via the acquirer to the issuer, and the merchant's account is credited. If and when the cardholder decides to pay off part of his/her outstanding balance, his/her account is debited. For real-world transactions, the technological channel can be 'none', 'contact', or 'contactless' (NFC, RFID, Bluetooth, etc.). For e- or m-commerce transactions, the channel involved is the Internet or mobile telephone lines. One level higher, the routing can take place via several kinds of networks, but the processing will typically be governed by scheme rules (L 3). However, for a Visa credit card used at the POS (ex 8), for example, the network involved need not be VisaNet. It can also be a non-bank network (that is, another processor such as First Data). Turning to layer 4, the form factor used in real-world transactions can vary dramatically. Correspondingly, (additional) authentication devices can be more or less advanced, and can be 'none', a signature, a PIN, biometrics, etc. MasterCard's PayPass (ex 9) uses RFID technology and can be incorporated in a traditional card, but also in other devices such as key fobs and mobile phones. No authentication is required for small purchases but a signature or PIN is necessary to validate payments over $25. For Internet payments, the 'form factor' is usually the card number – as most transactions will be so-called card-not-present (CNP) – and authorisation may entail the use of the expiry date, the Card Verification Code/Value, a PIN, or a one-time code.

Debit cards

Debit cards use practically the same matryoshka combinations as credit cards. As LEINONEN (2008, p. 3) points out, the difference between debit and credit cards lies 'not in the basic fund-transfer service, as the same technology is used for all card types, but rather in the other features'. One such feature is the payment delay (for a delayed debit card) or the availability of revolving credit (for a 'real' credit card)[16]. However, this is not visible in the classification since the focus is on the process of paying. Note also that in some markets, for example in Finland, banks now issue 'combi cards' that carry both a debit and a credit application. It is then up to the cardholder to choose, at the POS, between pay-now and pay-later. In Table 3, ex 10 details the layers of an Internet payment with a Bancontact/MisterCash (BC/MC) debit card in Belgium.

E-money

For certain forms of e-money, payment instrument and money (layers 5 and 1) can coincide, just like with banknotes and coins. But many e-purses are account-based and have shadow accounts that keep track of the balance. Proton and Visa Cash, for example, have such accounts, whilst Mondex does not. E-money payments are typical crediting (push) mechanisms (L 2). In layers 3 and 4, there is a wide range of possible combinations, which are clarified via examples.

The Internet payment scheme PayPal (ex 11) is a special case in that it uses either e-money (and a push mechanism) or giral money (and a pull mechanism) – the former when the account holder uses the balance in his account to make the payment, and the latter when PayPal acts as a front-end to an ordinary debit or credit card payment. Hence the mention of e-money as well as debit or credit cards in layer 5. The channel involved is the Internet or mobile phone lines, and the network is bank-owned in the EU and non-bank elsewhere[17]. The authentication device is the customer's e-mail address and password, plus, for m-payments, a six-digit security code received via SMS. eCash (ex 12), for its part, made use of 'coins' stored on

16 In many countries, debit cards can come with an overdraft facility on the associated current account.

17 In the US, PayPal is not an FDIC-insured bank, but claims to hold funds in regulated and insured banks (IBI, 2006, p. 135).

the consumer's hard disk, identified via specific serial numbers digitally signed by the issuing bank. eCash used the Internet for communication between consumers, merchants, and the so-called Mint, but banks acted as issuers of the coins. The Proton e-purse in Belgium (ex 13) is contact-based, and the network used to be owned by all Belgian banks but is now in possession of Atos Wordline. This is considered – in both cases – to be scheme network; the only difference is that it is no longer bank-owned. Note also that there is no authentication – as no PIN is needed – and the chip on the customer's debit card serves as the carrier or form factor. Octopus in Hong Kong (ex 14) is similar, but the channel is contactless and the network is a scheme managed by non-banks – public transport companies.

The form factor of Octopus can be a card, watch, sticker or mobile device. Scratch cards like the Wallie-card in the Netherlands (ex 15) use the Internet for transmission, whereas the network is operated by a non-bank. A server-based wallet carries the e-money, and authentication takes place via a PIN code. Dexit in Canada (ex 16), for its part, uses RFID to transmit the information from device (a tag) to terminal, and a non-bank operates the networks. Unlike with Proton (which works offline), with Dexit there is real-time processing. No PIN is needed. Finally, Tunz in Belgium (ex 17) uses the Internet or mobile lines for technical purposes whereas the network is a non-bank. The carrier or form factor is an e-wallet and authentication takes place via a PIN-code.

Loyalty schemes

Turning to the special cases in layer 6, loyalty points can be seen as a type of private currency (L 1) that is pushed instantly to the beneficiary (L 2). Little in general can be said about channel, form factor and authentication devices, but the network is typically operated by a non-bank (L 3). Loyalty schemes cannot readily be identified with one of the generic payment methods in layer 5. Loyalty points are not e-money because they are not pre-paid (but rather 'pre-saved'), and they cannot be assimilated with 'banknotes' because there is no open circulation. Hence their inclusion in layer 6.

Money transmitters

Money transmitters are specialised in cross-border transfers. They operate in parallel to or outside the banking system. As ex 19 in Table 3 shows, just about all matryoshka layers depend upon the specific set-up of the scheme. When cash is used, the mechanism is push.

Collection/billing services

This category includes all providers that collect and/or aggregate e-payments on behalf of the payee or the payer. We include PSPs[18] in this category, provided that they take active part in the settlement of funds. If they do not, they merely offer VAS. Such as VAS – e.g., Isabel eInvoice in Belgium – can be offered by banks as well as non-banks. Obviously, one and the same player takes care of both the e-payment and some VAS, turning it into a bundled service (e.g. T-Pay). Given the broadness of the category, the options in layers 3 to 5 are multiple. In layer 2, the underlying mechanism can be debiting/pull – e.g. Firstgate's ClickandBuy (ex 20) – or crediting/push, – e.g. in some cases Ogone and PayByCash. There are a multitude of possible networks/channels (L 3) and form factors / authentication devices (L 4).

To conclude this Section has demonstrated that in principle each real-world payment instrument can be assigned a generic payment method, a specific medium (form factor/authentication device, channel/network), payment mechanism and type of money.

[18] To be clear: all payment aggregators are PSPs, but not all PSPs offer aggregation services stricto sensu. Aggregation can take place at the level of payment options or at the level of the payments themselves. In the first case, a PSP offers an online platform comprising a range of payment options – from credit cards to electronic wallets and more – to other parties (e.g. online retailers) in a B2B environment. In this way, merchants can reduce the managing and maintaining overhead to each individual payment provider to a minimum. The payment solution aggregators, for their part, receive a fee for their service. Examples are Ogone, Bibit and Triple Deal. The business model of the second type of payment aggregators is completely different. Providers such as Peppercoin and Mollie aggregate individual micro-payments in order to reduce transaction costs.

■ Conclusions

The first set of concluding remarks are in fact observations rather than conclusions. First, developing the classification proved to be far more difficult than imagined. Stronger still, we are now convinced that the ideal classification does not exist. With hindsight, it is also interesting to observe that we started out with a complex classification comprising some 15 categories in layer 5, but ultimately ended up with a surprisingly un-innovative list of only 7 generic payment methods. The initial classification had separate categories for contactless payments and m-payments – besides 'ordinary' debit and credit card payments, etc. But after this brief spell of 'innovation infatuation', one soon comes to the realisation that quite often a contactless or m-payment is in fact essentially, say, a debit card payment. PayPass, for example, can be a credit or debit card payment or even e-money. The only thing that PayPass does is altering the technological channel. This is what led to opt for a generic approach, with a focus on the nature of the payment instrument in se.

Content-wise the model is, as explained, inspired by the IBI classification. There are, however, substantial differences. There is the inclusion of private currency in layer 1, but there is especially the introduction of two extra dimensions in layers 3 and 4. As shown, this avoids mixing up form factor and payment mechanism, and technology and payment method. Another plus is that, unlike the IBI model (and unlike ABRAZHEVICH, 2004; and STROBORN *et al*., 2004), the model in each step applies the same criterion to all payment instruments. Finally, the classification is more comprehensive in the sense that it incorporates VAS, albeit only at the periphery of the model.

This said, a general-purpose classification like ours does have a number of drawbacks compared to problem-driven approaches. In the latter approaches, payment instruments can be grouped more consistently, depending upon the focus. For example, when the focus is on risk, a different classification emerges than when the focus is on convenience. In the general-purpose approach, certain potentially important criteria had to be disregarded: dimensions such as anonymity, risk and size are not taken into account, the presence of a credit line is not visible, one is unable to distinguish between e-purse schemes that process transactions in real-time or not, and one is unable to discern multi-purpose from single-purpose payment instruments such as pre-paid calling cards. However, in the model, all existing real-world payment instruments can be distinguished from one

another. This is a major advantage compared to problem-driven categorisations in which some instruments are excluded or lumped together. A final drawback of the classification is that it requires detailed knowledge about the functioning of payment instruments. But this can also be a plus, as it forces one to ask all the relevant questions. Finally, while the model is more structured, it is also flexible. It enables to pick and choose in bringing real-life payment instruments 'back to their roots'; that is, back to their essential features. In this way, it shows, for example, that the line between e-money and giral money can be a thin one and that m-payments are not always as innovative as they seem. Given the way it treats technology, the classification should also be relatively future-proof.

References

ABRAZHEVICH, D. (2004): "Electronic payment systems: a user-centred perspective and interaction design", Ph.D. Dissertation, Technische Universiteit Eindhoven.

BÖHLE, K. (2002): "The innovation dynamics of Internet payment systems development", Institute for Prospective Technological Studies Report 63, Sevilla.

Cap Gemini Ernst & Young (2003): "Mobile payments: money in your hand", Interim Report.

European Central Bank:
- (2002): "E-Payments in Europe – the Eurosystem's perspective", Issues Paper.
- (2003): "The Electronic Money Directive: Recapitulation and outlook", Working paper for the GTIAD-meeting of 27 November 2003.
- (2004): "E-payments without frontiers", Issues Paper for the ECB Conference on 10 November 2004.
- BANK (2008): "Report on retail payment innovation 2006", Interim Report, November 2008.
- (2009): "Payments and Markets Glossary", s.a.

European Commission (2009): "Directive on Payment Services", November 1, 2009.

HARTMANN, M. (2006): "E-payments evolution", pp. 10-18, in T. Lammer (Ed.), *Handbuch E-Money, E-Payment & M-Payment*, Springer, Heidelberg.

IBI RESEARCH (2006): "Secure payment methods for E-government", *E-Government Manual*, Universitat Regensburg.

Innopay:
- (2008): "Internet payments in Europe", Online Payments Report 2008.
- (2009): "Online payments 2009", European Market Overview.

KREYER, N., POUSTTCHI, K. & TUROWSKI, K. (2002): "Characteristics of mobile payment procedures", pp. 10-22, in Z. Maamar, W. Mansoor & W.-J. van den Heuvel (Eds), *Proceedings of the ISMIS 2002 Workshop on M-services*, Lyon.

KRUEGER, M. (2002): "E-money regulation in the EU", pp. 239-251, in R. Pringle & M. Robinson (Eds), *E-Money and Payment Systems Review*, London, Central Banking.

LEINONEN, H. (2008): "Could transparent pricing increase payment efficiency and competition at point of sale?", *Mimeo*, Bank of Finland, November 3, 2008.

LYCKLAMA, D., LIEZENBERG, C. & SMORENBERG & H. (2006): "Model voor betaalcontexten: een andere manier van segmenteren van betaalinstrumenten", Innopay Report.

PARHONYI, R., NIEUWENHUIS, L. & PRAS, A. (2006): "The fall and rise of micropayment systems", pp. 343-362, in T. Lammer (Ed.), *Handbuch E-Money, E-Payment & M-Payment*, Springer, Heidelberg.

PEIRO, L., ASOKAN, N., STEINER, M. & WAIDNER, M. (1998): "Designing a generic payment service", *IBM Systems Journal*, 37(1), 72-88.

STAHL, E. (2006): "Zahlungsabwicklung im Internet, bedeutung, status quo und zukünftige herausforderungen", *Studienergebnisse*, Universitat Regensburg, Germany, October 10, 2006.

STROBORN, K., HEITMANN, A., LEIBOLD, K. & FRANK, G. (2004): "Internet payments in Germany: a classificatory framework and empirical evidence", *Journal of Business Research*, 57(12), 1431-1437.

YU, H., HSI, K. & KUO, P. (2002): "Electronic payment systems: an analysis and comparison of types", *Technology in Society*, 24(3), 331-347.

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