

Does Anyone Really Need MicroPayments?

Nicko van Someren (Moderator)¹,
Andrew Odlyzko², Ron Rivest³, Tim Jones⁴, and Duncan Goldie-Scot⁵

¹ CTO, nCipher Plc.

² University of Minnesota

³ Founder, PepperCoin Inc.

⁴ Founder, Mondex Plc.

⁵ Editor, E-Finance Magazine

Abstract. Many cryptographers have tried to develop special technology for transferring tiny amounts of value; the theory being that the computational and/or administrative costs of other payment schemes render them unsuitable for small value transactions. In this panel we discussed two major questions: firstly are the existing systems really not useful for small values and secondly might other models such as flat rate or subscription systems be more suitable anyway, and be possible without the need for small payments?

1 Introduction

This panel session set out to examine the failure so far for any MicroPayment scheme to take off and asked if the reason for this might be that such schemes were not actually needed. Panellists were asked to provide their perspective on two main issues. Firstly, are existing payment schemes actually good enough for handing small value payments and thus there is no technical need for different, small value oriented systems. Secondly, were there in practice other payment options such as subscription models or aggregated payments that obviated the need to ever handle small value transactions.

The four panellists came from a variety of backgrounds, in the hope offering a wide set of perspectives. Andrew Odlyzko has published extensively on issues surrounding payments both while at AT&T and as a professor at the University of Minnesota. Ron Rivest, as well as co-inventing the RSA algorithm and being a professor at MIT has also designed a number of MicroPayments protocols and is one of the founders of PepperCoin, a company that plans to deliver a stochastic based MicroPayments system. Tim Jones was the founder and CEO of Mondex, a digital cash system based on stored value smart cards which allowed for transactions at essentially zero marginal cost and thus is suitable for certain types of MicroPayment problems. Duncan Goldie-Scot is a journalist who has been observing the digital money space for more than a decade and has written extensively on the rise and fall of various payment systems.

2 Andrew Odlyzko

Andrew Odlyzko opened the discussion by stating that he had been working on MicroPayments for many years and that he hoped that some of the patents he held in this space might one day be worth something. That said, he presented a fairly pessimistic view on the prospects for the technology and supported this with four "Fundamental Reasons MicroPayments Will Never Happen".

The first reason he raised was that users take a long time to accept new payment devices, especially if there is specific coercion to make a change. He illustrated this with the US dollar coin. Asserting that most observers outside the US are unaware of the fact that the US has a dollar coin at all he mentioned that failure of the "Susan B. Anthony" one dollar coin which had failed to gain widespread use. The more recent "gold" dollar coin has had such limited use that only three of the dozens of American audience members had made use of one. Odlyzko pointed out that while European countries had succeeded in introducing similar value coins (one UK Pound, ten French Francs, one Euro and so fourth) the migration had been forced by the withdrawal of the paper equivalent. Since such coercion was never going to take place for payments on the Internet he suggested that user inertia would always inhibit the growth Internet cash systems.

Odlyzko's second point was that vendors would prefer to sell bundles of goods and services rather than small quanta, because in general they can extract more money from the buyers that way. He illustrated the theory and practice of this with the example of Microsoft selling the full suite of Office products for much less than the sum of the prices of the individual components. The argument presented was that if vendors tend to sell in large blocks rather than small quantities then the need for MicroPayments is reduced.

The third thread of argument was that flat rate, rather than metered usage encourages greater use of a service, even when in practice the user may end up paying more. Odlyzko produced extensive evidence that users of telephone services much prefer flat rate charging for calls and metering reduced consumption even when the metered rate was cheaper. Given that flat rate pricing is preferred by the user the need for small payments is again diminished.

Finally, Odlyzko presented the idea that anonymous payment schemes were disliked by merchants because they got in the way of price discrimination, which is valued by vendors as a way of getting the most from their customers. There is a long history of differential pricing for different customers (or classes of customer) and he asserted that having anonymous payments meant that the merchant could not discriminate between the customers. Since MicroPayments tend to be anonymous, as a frequent way to reduce the transaction cost is to do away with much of the accounting and associated book keeping, such schemes inhibit price discrimination and are thus shunned by vendors.

Attendees were referred to an extensive selection of papers, reference material and other essays which are available on the Internet at:
<http://www.dtc.umn.edu/~odlyzko/>

3 Ron Rivest

Ron Rivest started by stating “Is there a need for micropayments – absolutely!”

He commented that while Odlyzko has compared MicroPayments against subscriptions in an either-or manner Rivest felt that they could coexist and each have a significant market share.

Defining MicroPayments as payments under \$10, the domain where the processing cost is high relative to the value of the transaction, Rivest looked particularly at purchases of informational goods where the marginal cost of production is zero.

Rivest produced some statistics for the paid Internet content market for the first quarter of 2002. The market size for information downloads was said to be about \$300 million and growing at a rate of 100% a year. Of this content:

- 50% was sold as annual subscriptions
- 30% was sold as monthly subscriptions
- 14% was sold as single purchases
- 6% was sold as other subscriptions (e.g. 6-month)

The 14% of current paid internet content as pay-per-use was compared with (paper) newspapers, where about 31% is pay-per-use. It was pointed out that this implied that pay-per-use content on the Internet, with a suitable payment system, would likely take between 14% and 31% of the total sales, which in a \$300M a quarter market is a fairly significant market share even if subscriptions continued as the dominant means of payment.

Rivest went on to mention the recent introduction by a mobile cellular phone provider of a ‘*69’ service¹ on a subscription basis (\$3/month); this was a total flop. When they re-priced it as 75¢/use, it sold beautifully. *“The surest way I know to kill a new service is to make it available only via subscription.”* It was suggested that new users often like pay-per-use to try out new services; they may eventually become subscribers, but providing users with the ability to experiment cheaply with a new service can be a powerful way to acquire customers.

Rivest then quoted another recent study which estimated that the market for downloading articles was about \$1.6 billion annually; much of this market is for single-use purchases.

Next Rivest raised the question “Is there a ‘killer-app’ for micropayments?” He suspected that there is, and that it is for music downloads. He asserted that the music industry is in big trouble; the incumbent players are struggling to find a new business model despite realising that their old ones are not working. They realise that they need to reprice, downwards, but don’t know how to do that and have it make economic sense. A recent study by Forrester says that digital music downloads will generate \$2 billion in new sales annually within five years, and that 39% of this new revenue will be from downloaded singles.

¹ Dialing *69 calls back the last party to call your phone line.

A related market study by Ipsos-Reid (Dec. 2002), is entitled, "U.S. Music Downloaders Prefer a Pay-Per-Download Transaction over Current Subscription-Based Offerings" was quoted. It found that:

- 28% of those over 12 years old have downloaded songs over the Internet (about 60 million people, and the figure is increasing)
- 31% of downloaders report having paid to download music; this indicates an increased willingness to pay for downloaded music.
- 27% of downloaders prefer a fee-based system, with 19% preferring a pay-per-download, while only 9% preferred a subscription system. This is a two-to-one vote in favor of pay-per-download.

Rivest also noted that the mobile ringtone market is now \$1 billion per year and that this is entirely pay-per-download.

Moving on, Rivest noted that in that morning's² New York Times, there was a story entitled: "6 Retailers Plan Venture to Sell Music on the Web". The new venture is called "Echo", and the retailers include Best Buy, Tower Records, Virgin Entertainment, and three others. The article notes that CD sales have dropped from 785 million units in 2000 to 681 million units in 2002. The new venture may have pricing similar to Universal's current web site, at 99¢ per single download and \$9.99 for an album. The article also noted that prices in the music industry also needs to come down.

From this Rivest concluded that Pay-per-use and pay-per-download will always be a significant part of the payment scene, especially in music. To actually make this happen, he asserted, one needs to keep transaction processing costs small. He noted that one current web site is selling singles at 99¢ each, but paying 35¢ to have each 99¢ payment processed by the credit-card company.

He went on to suggest that probabilistic payment customized to handle small amounts can help, citing his own work with Silvio Micali (which lead to the founding of Peppercoin) as well as work by Andrew Odlyzko and, in that morning's conference session, Levante. He noted that furthermore Moore's Law also helps, since one can now do an RSA digital signature faster than you can access the hard drive.

Raising the issue of "bearer-based systems", where possession of the bits is equivalent to possession of the value, Rivest lamented the absence of Financial Cryptography founder Robert Hettinga who had originally been scheduled to join the panel but noted that the Mondex system, developed under the auspices of Tim Jones, was also essentially a bearer system. Rivest stated that he had a fundamental problem with bearer-based system because of the ease with which bits, as opposed to atoms, can be copied. Therefore, he asserted, a bearer-based system can not exist without a global database to check for duplicates and in the end, it would be easier to have an account-based system, with smaller per-user databases of receipts and expenditures.

² The panel session took place on January 27th, 2003

4 Tim Jones

Tim Jones opened by stating that throughout history the vast majority of transactions had been based on the direct exchange of value for goods and services, rather than subscription based transactions. Why should the move to the electronic world fundamentally alter the payment choice that has been constant for hundreds of years?

He went on to say that often new technologies take in unexpected ways. For instance, the SMS³ facility in GSM telephones was an afterthought to the original design but has not only gone on to be a major source of revenue for the phone companies has also spawned an entire youth culture. Jones illustrated this with an anecdote about driving along the motorway with his daughter and a friend of hers when they were passed by another car full of young men. When they men in the car saw Jones' daughter they pulled along side and held up a piece of paper with a cellular phone number on it, initiating a conversation by text message, rather than voice, which resulting in the girls going clubbing that evening with the occupants of the passing car.

Jones went on to discuss the way in which MicroPayments, and in particular peer-to-peer payment protocols, might be used to help the open source software community. He suggested there the current situation in which a great deal of good software was being developed by unpaid volunteers was not economically sound but that the range of payment options to reflect the value that people in this business world are creating is not adequate. This, he said, seems like a case where there are peers who appreciate value, and could assign it. If there were an effective way for lots of people to make small donations with ease then open source software authors would likely get great benefit from such a system, especially for popular software which gets used very widely. As an example pointed to the scenario where currently software is available in a "free" form and also in a "pay" form. If there were a viable mechanism to accept a payment of 50¢ then there might be no need for the free version but if millions of users each paid that amount then the author would be (extremely) well rewarded for their work. In the current system he stated that we are not exploring properly the price elasticity of demand.

Exploring the use of electronic cash in the physical world, rather than the on-line world, Jones stated that there were often cases where people were involved in low value transactions and it would be disappointing if electronic payments could not cope them. By way of an example he cited the case of the school bake sale where the purchaser is aged 7 and merchant ages 9 and historically their payment processing system consisted of a small box containing a few coins. He pointed out that the Mondex electronic cash system could cope with this scenario.

In general Jones was fairly optimistic about micropayments but he was less convinced that music would be the "killer app". He thought it was more likely that the killer application would end up surprising us all. In any case, it was

³ Short Message Service

perhaps important to get a system up and running, so that these applications could be built and tried out. He thought that it was quite possible that the killer application would be open-source downloadable software, such as plug-ins. With the right price points (e.g. 50¢ per download), software creators could make a lot more money than they could by charging say \$30 for a retail box with the software. Downloading a plug-in for 50¢ for say an Adobe plug-in is a “no-brainer” he asserted and so everyone who thought that they might need the software would be willing to pay, as long as the payment mechanism was there.

Finally, Jones said he wanted to enable almost anyone to become a merchant. He reiterated the example of children selling cookies for a bake sale, and wanted them to be able to do similar things on the Web.

5 Duncan Goldie-Scot

Duncan Goldie-Scot opened by saying that in his time as a journalist writing about electronic money schemes he had examined 29 systems and 28 of them failed. He noted how hard it is to get the business model right and said that most payment systems failed because they aimed for “global domination”, which he felt just isn’t on the cards. He thought that by aiming for smaller markets, one could succeed.

Goldie-Scot suggested that the use of payment systems is governed by transaction costs, by the economics of the process. As processing costs collapse so average transaction value can and will fall until we end up with MicroPayments. As these MicroPayments become possible so new markets and new payment models will emerge.

Referring to Andrew Odlyzko’s argument for flat-rate pricing he stated that this is not incompatible with micropayments. He said that it is an historical anomaly that we pay our flat-rate internet accounts monthly. Accounts payable and accounts receivable departments only exist because batch processing makes economic sense. When it becomes economically viable to pay the flat-rate more frequently – weekly, daily or by the second – then it is to the cash-flow advantage of someone to do so. \$20 a month for 100m AOL users adds up to \$2bn in the wrong hands – either the consumer or AOL depending on whether it is paid in advance or arrears. That carries a real economic cost. If it were technically possible to pay for everything in real-time there would be huge gains in economic efficiency. But paying \$0.0000077160 per second is not yet viable.

Goldie-Scot went on to raise the example of British Gas. British Gas sends out 120 million bills a year, quarterly in arrears. Assuming the average bill is for \$300, some \$36bn is tied up in the payment system. A common gas utility (Transco) manages pipes that are used by all the players in the market. British Gas pays the wholesale price of gas from the gas pool and charges its customers the retail price. Their only real business is managing customer accounts. Keeping track of its customers is a difficult business, as is chasing bad debts. These two elements, the cash flow cost and the cost of knowing and billing the customer, account for the greater part of each gas bill.

If British Gas could develop a model in which they were paid cash on delivery and if they didn't even have to know who their customers were, they could strip out a large part of their cost base. If one could TCP/IP enable gas meters that could be linked to bank accounts, token issuers or some online payment mechanism – pay as you go – then you would change the economics of the retail gas market. One could envisage cash on delivery for gas, electricity, water, telephony, music, video – indeed anything that streams.

6 Debate from the Floor

A number of interesting questions were raised from the floor and a lively debate ensued. While a full transcript of the debate is not available we highlight here some of the questions and answers.

In the context of Tim Jones' comments about desiring digital money schemes that work for the school bake sale as well as for larger scale transactions, it was asked what a ten year old might want to sell on-line. One answer was that she might well want to sell her own songs, to her friends. Another was that it was the size of transaction that mattered and that the Open Source community would find it fruitful to be able to accept transactions on that scale.

The issue of the real cost of credit card transactions was raised, with one attendee citing that he had had cause to pay a toll of 1,000 Italian Lira, about 55¢ at the time of writing, on an Italian motorway and that the toll booth had been willing to take a credit card for the transaction. It seemed unlikely that the Italian government were paying a 25¢ overhead for that transaction. On the other hand another delegate pointed out that the State of California charges a \$4 surcharge on all credit card transactions, irrespective of size, as it is supposedly easier than working out the real cost. It was generally agreed that much of the charge to the merchant was related to the cost of fraud; in places where there was likely to be less fraud the charges are lower. It was also commented that a large part of the cost is credit risk and thus transaction charges on debit cards are lower than on credit cards.

In the context of charging of phone calls it was pointed out that in Europe the use of pre-paid mobile phone services had overtaken the use of subscription services. Andrew Odlyzko said that this had resulted in a fall in the revenue per subscriber and suggested that this was evidence for his model but Tim Jones countered that this was in fact simply indication that the market was maturing; the revenue per subscriber for users in each class off subscriber had remained fairly stable but the mobile phone companies were now extracting money from new, less well off, users and while the total revenue was going up the effect of these new users was necessarily to bring the average down.

The next topic to come up was to do with the attention span of users and their willingness to make conscious decisions about payment. Andrew Odlyzko pointed to research from his time at AT&T in the mid seventies when metered local rate calls were tried. They were unpopular, even with the people who benefited from lower call charges as a result, and one of the reasons cited was to

do with the user not wanting to have to make a decision about cost. Ron Rivest stated that MicroPayment schemes would need to be very easy to use to become popular and pointed to work by Dan Ariely at the MIT Media Lab regarding the handling of this. Tim Jones suggested that this was really all part of the more general problem of user acceptance of the payment technology.

Ron Rivest questioned Andrew Odlyzko's assertion that price discrimination was impossible with MicroPayments. Odlyzko replied that it was not impossible but that anonymity made it harder. It was pointed out from the floor that the tacking system used by merchants such as Amazon were more or less orthogonal to the payment processing side.

7 Conclusions

Despite the wide variety of positions represented during the course of the discussion the general consensus seemed to be that MicroPayments do have some roll to play in the future of digital money. It is far from clear what form they will take but there is clearly a need for a simple, easy to use payment system for small value transactions which will not consume too large a fraction of the transaction value in processing charges. While such a system is unlikely to dominate the on line payments space the total value of even a modest fraction of all payments represents a huge amount of money.

In short, yes, we probably do need MicroPayments.