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Authentication and Payment Solutions

Electronic Wallets: Past, Present and Future

A means to authentication and payment for device-independent electronic payment instructions

At a glance

This whitepaper outlines the background of the wallet concept, the role of wallets in society and the need for electronic wallets as we enter the Information age. A focus is the need for individual identification and the ability to exchange value which is now converging in the single process of authentication and payment. Identification mechanisms are explored culminating in the need for device-independent authentication from any Internet access point. Similarly, the exchange of value is examined reinforcing the need for payment in business and highlighting the expected trends for future payment methods. The whitepaper also provides insights into the future capabilities of electronic wallets and the role they will play in eCommerce.

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Electronic Wallets: Past, Present and Future

Background

Wallet /ˈwɒlət/ *noun* **1**. a small, booklike folding case for carrying papers, paper money, etc., in the pocket. **2**. a bag for holding food, clothing, toilet articles, or the like, as for use on a journey. [Middle English]

The Macquarie Concise Dictionary

The history of wallets

Wallets have been used for thousands of years to protect and carry personal items of value. The earliest wallets or satchels were a piece of cloth tied with a piece of string which enabled a range of items such as coins to be carried to market. Humans have always been mobile and have needed a container to securely carry personal items of value while in transit. New modes of transportation have accelerated human mobility across the globe increasing this need.

Wallets have evolved in shape and form but today they are still characteristically made of leather. The inventory of a wallet now includes a range of valuable items including coins, receipts, paper notes, credit cards, debit cards, driver's licence, loyalty cards, merchant cards, medical identification cards, security access cards and business cards. The information contained on many of these plastic cards enables us to identify ourselves to particular organisations such as banks and shopping stores and can enable us to transfer value using a range of payment options. Items such as credit cards are now almost universally accepted forms of payment in most countries.

As humans evolve towards a continuous state of connectedness through the use of information technologies they will use electronic representations of their familiar items of value. These items have travelled with humans for thousands of years and will continue to travel with them indefinitely. To meet the needs of the digital world electronic wallets will begin to co-exist with physical wallets. Just as wallets moved from cloth to leather, they will now move from leather to the Internet in order to travel the new information highways used by human society.

Wallets as a cultural phenomenon

Almost every adult carries a physical wallet or purse of some description. Young children are trained at an early age to carry and safeguard their personal items of value and are introduced to wallets in the normal course of growing up. In particular children are often given a wallet when they first have to carry items of value such as coins or paper notes. The relationship between a wallet and value is closely interrelated due to this connection made during the initial stages of a child's development.

An interesting thought is to imagine a child being introduced to this process in the year 2020. What sort of training will this child receive in safeguarding his or her personal items of value?

Human nature to consume

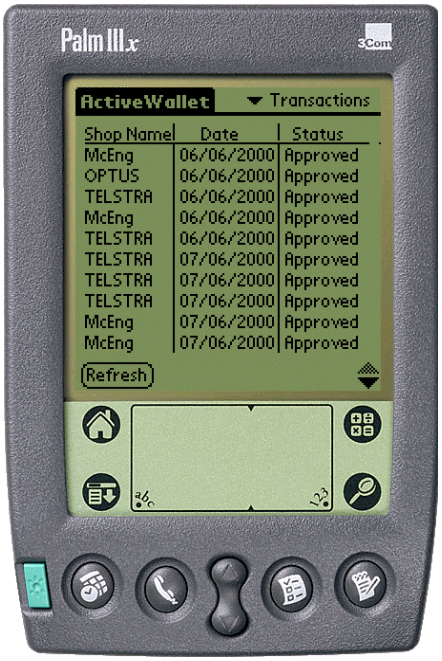
People consume for both necessity and pleasure. Basic items such as food and clothing are purchased on a regular basis but people also purchase goods which are purely for enjoyment or recreational purposes. People access their wallet every time they wish to make these purchases. This is a reflex which is so deeply embedded in the human psyche that they are not conscious of the process of retrieving their wallet from their pocket and opening it.

People automatically take their wallet with them whenever they leave their home even when they do not intend to make a purchase. The presence of a wallet gives a person a sense of security and protection. If an unexpected event occurs which requires payment they will be able to meet this obligation. In the case of a crisis they will have emergency contact information readily available. If the opportunity to make an impulse purchase arises they will be able to immediately fulfil this desire.

The electronic age

With the advent of the electronic age the concept of value was transferred to plastic cards with a magnetic stripe which securely carried personal account information. These plastic cards allowed a person to access value through a global network of automatic teller machines and EFTPOS devices. However, this only solved part of the problem as the means of accessing value could only move with the human being in the physical form of a plastic card. If the card was lost or stolen the individual was unable to access their accounts. A loss of a card could also open the card to fraudulent behaviour destroying the value of the card.

The full freedom from a physical presence was not perceived as a necessity prior to the introduction of the Internet. The virtual world gives a new dimension to human mobility and humans now need the ability to identify themselves and access their items of value from any point of connection to the network. These access points include personal computers, personal digital assistants, mobile phones, settop boxes, games consoles and Internet appliances. This requirement is a necessary element for human interaction in the virtual space and the foundation for eCommerce. Wallets now need to travel with us freed from the constraints of the physical world.



Furthermore, with the emergence of eCommerce human consumption is no longer limited to physical location. For this reason the electronic wallet now needs to reside at a trusted location on the global network and be accessible from any Internet access point. Mobile commerce will begin to proliferate when humans are able to access their network wallet from any location at any point in time. This will allow humans to purchase products remotely as they can utilize any connection device to effect a transfer of value in exchange for a commodity.

The connected world

The single greatest freedom in today's world is the ability to communicate regardless of physical location. This is the very reason humans invented communication media such as the telephone, radio and television. Today humans are permanently connected thanks to the devices, which they carry in their pockets and reside on their desks in the home and in the workplace.

Personal computers were possibly one of the major steps in enabling humans to virtualise their thoughts, actions and even their identity. The Internet gave human beings a new dimension in being able to extend these attributes across a global network. The addition of mobile devices further expands the virtual presence so that it can be accessed from any physical location.

When at home or at work, the PC provides a suitable vehicle for users of an electronic wallet. As we move from a physical wallet to an electronic wallet the access device must be convenient to carry and use. Wireless technology such as PDA's and mobile phones provide this and are already common today.

In a connected world the means of connection will change from moment to moment. As we move through the physical world these connection points, such as mobile phones, may move with us. At other times we will seek out an access point to the Internet – possibly one that we have never used before.

Our electronic wallets face the challenge of moving with us within these various means of connectivity. Wallets now need to change shape, form and size depending on the access point while delivering the same information and capabilities to us. Humans have become omnipresent and their tools must strive to do the same.

The Virtual Representation of a Person

In the online world the physical person becomes less of an emphasis and we see the emergence of a virtual representation of the person described by the technology they use. The Internet introduces a global network, which enables the human being to become globally present in the form of a virtual person. This virtual person has access to private information and can perform tasks on behalf of its human counterpart including the exchange of value.

The virtual person acts as an agent for its human counterpart and as such needs to be verified as representing the actual person. It must not be possible for another person to imitate the virtual person of another person or gain access to the capabilities of another person's virtual identity.

The technology industry has attempted to provide the answer for this virtual person and satisfy its needs in the electronic age. This is especially evident when business starts to be conducted in an electronic form. In the electronic age people can carry out business without being physically

present and this is possibly one of the major achievements of electronic commerce both for businesses and individuals.

Now that the human being is virtually present the recognition of his identity and the ability for him to exchange value become fundamental issues. When we can no longer recognize a person's face or signature the person cannot be trusted to act and exchange value. In the online world *identity* and e*xchange of value* correspond with *authentication* and *payment*. The Internet presents a new requirement, which is the ability to converge authentication and payment in a single process. The solution to this requirement is an electronic wallet, which can be utilized from any Internet access point.

Emergence of electronic wallets

Recent attempts to satisfy the needs for authentication and payment required for effective electronic commerce have had limited success. These attempts have either addressed the issue in a partial manner or deviated from the original purpose by offering inadequate solutions.

Electronic wallets have ultimately had little or no success in attracting substantial take-up and to date the adoption of electronic wallets has been negligible. This has been due to a lack of maturity in the technology, absence of industry standards and a general lack of understanding. Furthermore, most of the major technology providers have attempted to respond to the need for an electronic wallet but have done this within the constraints of protecting their existing systems. The Internet calls for a new approach designed for a world of distributed Internet devices.

The future of electronic wallets is an evolutionary process, which needs to address the issues of identification and exchange of value over the Internet in an easy and reliable fashion. Electronic wallets will not succeed until these necessities are achieved. For electronic wallets to become ubiquitous they must retain the functionality and usefulness of physical wallets and also provide new functionality, which takes advantage of the Internet medium.

The new challenge

Technology faces the greatest challenge of all time – that of taking all that human beings are accustomed to with them to the digital world. The focus here today is taking their method of exchanging value and the recognition of their identity with them and freeing these from physical boundaries.

Firstly, we need to examine the evolution of forms of authentication and payment. This will demonstrate that these are familiar concepts, which now need to be adapted for virtual persons interacting in a virtual world. We then need to provide these capabilities through an electronic wallet.

Methods of Authentication

The following is a brief evolution of the means of identification in society. Rather than being an exhaustive comparative study it merely attempts to summarize the various ways in which people have sought to identify themselves. This highlights the fundamental need for authentication in any transaction.

Authentication Method	Description
Names	Names were a convenient way of identifying individuals in a small community. A person's name was closely linked with reputation and this was the 'bond' when entering transactions which required a requisite degree of trust. Names proved to be ineffective when dealings began to involve people outside the community. This not only introduced uncertainty but also led to duplication where common names were no longer unique to an individual.
Seals	The affixation of a seal to an envelope provided certainty that the contents had remained confidential and that the information contained was delivered from the sender. Seals overcame the duplication problem of names but could themselves be duplicated given a skilled tradesman. Seals were predominantly a means of identification for the wealthy and did not become a universal form of identification in society.
Fingerprints	Fingerprints are a characteristic of every human being and uniquely identify them. They are almost impossible to impersonate, which has led to their widespread use in criminal investigations and in passport issuance. However, fingerprints were very complex to compare and needed to be physically viewed in order to be recognised.
Physical Signatures	Physical signatures are an effective means of identifying a people in a literate society. They are unique to individuals and can be easily compared by the human eye. For this reason they have become ubiquitous in transactions ranging from credit card purchases at the point of sale to home loan applications. Unfortunately they require a physical presence for creation and are applied to paper. This relegates them as unsuitable for online identification.
Physical Keys	Physical keys are a means of providing access to authorised individuals and have become the most common means of accessing premises. The security of physical keys is compromised when the keys are lost. Physical keys can also be duplicated by a locksmith which reduces their security.
Username and password/PIN	Username and password has become the defacto standard for identification of individuals in the online world ranging from email to e-banking websites. These passwords are independent of a physical medium or device which makes them suitable for online identification. However, the drawback is that users are now required to use many passwords which can become burdensome on the individual to remember. Furthermore, the security of a password or PIN based system depends on the individuals choice and safeguarding of the password.

Authentication Method	Description
Digital Certificates	Digital certificates were specifically designed for electronic identification and are effective in a closed system. However, certificates are generally issued to a physical hardware device which means they are not portable across multiple Internet access points. They are also difficult to administer and maintain, especially when re-issuance is required. Their value depends on the credibility of the trusted party which issues them and the procedures which must be followed before they are issued.
Biometic, Voice Recognition, Retinal Scanning and DNA matching	The new forms of identification come in the form of biological measurement. Electronic fingerprint scanning using biometric devices on PCMCIA card has already reached production. The other biological authentication technologies are still not viable as a widespread identification mechanism. The major drawback is that each of these methods require expensive hardware in order to become effective. This hardware is not going to be accessible at every Internet access point in the short term. Additionally, some of these methods need to be coupled with another means of identification in order to guarantee authenticity.

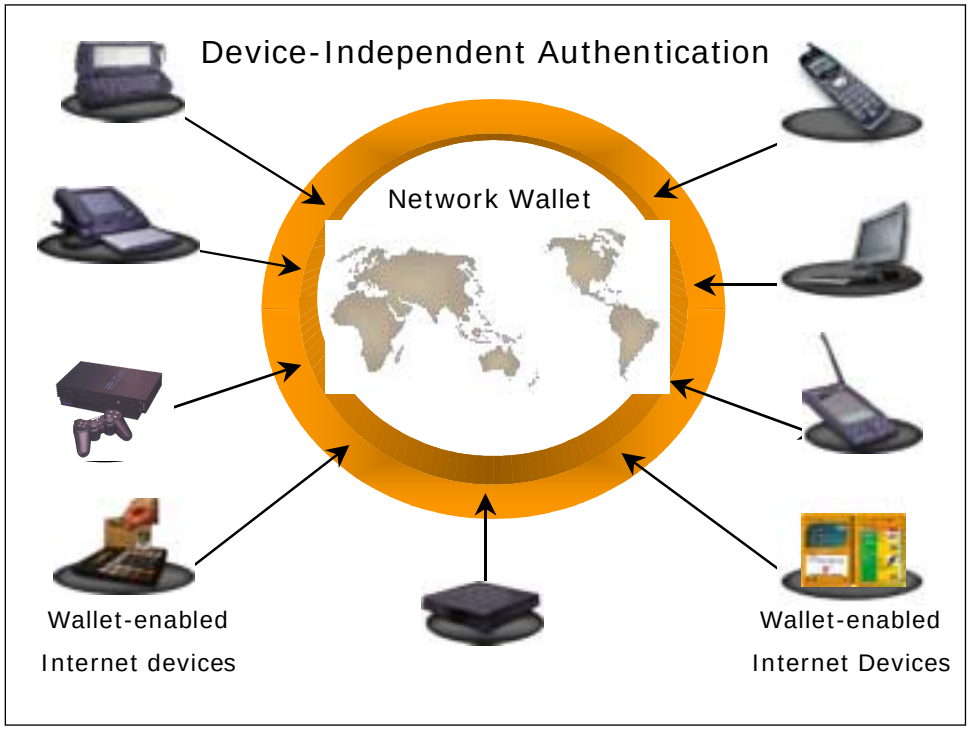
Device-Independent Authentication

As we move forward in the electronic age we experiment with different means of authentication to enable effective eCommerce. To add to the complexity of the task we now move from device to device and access point to access point. We are now connected through our personal computers and telephones as well as our PDAs and mobile phones. This poses new challenges and forces us to think of alternative means of authenticating the user in order to allow him to participate in eCommerce.

We can no longer rely on existing means of authentication as they were mostly designed to be dependent on the device or network to which they connect. It is now necessary to separate the authentication process from physical devices and move this capability to the network. Only this approach will give the individual the ability to be recognised anywhere and anytime using any device.

For this to occur it is necessary to bring the individual a device-independent environment as opposed to confining the individual to an environment dictated by the device he is currently utilizing. For example, mobile phones offer their own means of authentication which differs from the means of authentication on other devices. The ability to use a mobile phone to be authenticated is only a partial answer to the greater question of mobility. The ultimate answer needs to embrace all devices and all access points – it needs to be a standard by which a user can participate in the electronic commerce from a mobile phone, a PDA, a PC, settop box, internet fridge or a games console.

For eCommerce to flourish we must use the device as simply an access point with partial authentication. This then needs to interact with an authentication mechanism which is omnipresent and ultimately resides on the network. This gives birth to hybrid systems that can bring together multiple elements and include many of the authentication mechanisms available in the market. An electronic wallet which is available to users from any device seems to be a logical manifestation of this concept and a solution to the existing conundrum. Once authentication occurs, the exchange of value may proceed. This concept is central to secure eCommerce.



Methods of payment

The following is a brief evolution of the various means of payment. This is simply a summary of the different ways in which people have sought to exchange value in return for goods and services. It demonstrates the fundamental role of payment in business.

Payment Method	Description
Barter or goods exchange	Barter was an initial form of exchanging goods and was used primarily in an agricultural-based subsistence economy. Barter is limited in that it does not provide for an accurate valuation of the goods which are being exchanged. It is also limited to a local environment.
Coins	Coins were originally made of precious metals which encapsulated the value of the coin. They were the first means of transporting value and provided a more accurate means of exchange. The major drawback with coins is that carrying them in quantity is cumbersome and the denominations require addition to be performed to meet the required value in a transaction. Coins are different in different regions and do not facilitate cross-border transactions.
Promissory notes/cheque	Promissory notes are simply promises to pay a particular value on a particular date which are usually settled in currency. After a promissory note is signed it allows the value to be transported without the holder being present. The promissory note is a negotiable instrument which can be transferred a number of times before expiry. These notes are open to fraud as they rely on physical signatures. Promissory notes served as the precursor to the cheque which is still a common payment in today's society.

Payment Method	Description
Bills of exchange	Bills of exchange expanded upon the promissory note concept by introducing a third party intermediary in the form of a trusted financial institution. Bills of Exchange allowed the exchange of value without any existing relationship or physical meeting using this third party. This was important in opening up International transactions but introduced a transaction cost payable to the third party intermediary for taking the risk position.
Paper bills	Paper bills issued by a government provide a frictionless means of exchanging value in a particular region. They have become the most common form of exchange in today's society and are easier to carry than coins. Paper bills are limited in that they require currency conversion in cross-border transactions and cannot be used in the virtual world.
Plastic cards	The introduction of credit and debit cards provided a means of effecting electronic payments. Due to their electronic nature payments made with these plastic cards could be made in different regions across multiple currencies with the issuing bank performing currency conversion in realtime. These have become a popular means of payment in the physical world where they can be complemented with a signature or PIN number to provide authentication.
Stored value cards/smartcards	Smartcards are essentially plastic cards with greater storage capacity and the capability to hold certificates or small applications. Smartcards can be used in the digital world to hold and dispense value in transactions. However, they are primarily hindered by their physical form and the lack of compliant devices such as smart-card readers which are not present at every Internet access point.
Electronic payment instructions	Electronic payment instructions are the newest form of payment. These are simply digital instructions which inform a financial institution to debit or credit an account. Examples are the use of a credit card number on the Internet or a pseudo card number carrying a debit payment instruction. These payment instructions are currently lacking a simple and effective authentication capability which exposes them to fraudulent practices.

Multiple Payment Methods

Throughout the ages the methods of payment have evolved and provided effective means for exchange of value. This has ultimately created the business world we have come to view as an integral part of our lives.

The emergence of an electronic world and the rise of eCommerce has forced us to once again invent new payment mechanisms. Without payment there is no business and eCommerce cannot exist without effective means of exchanging value.

Most of the forms of payment that have evolved with us to date have remained in one shape or another. However, many of these are not able to make the transition to the electronic world in their current form. In addition, the constraints and the requirements of the electronic world enable both simplified and more sophisticated ways of exchanging value.

To give an example, the concept of electronic cheques is contradictory in its essence. Cheques are designed for the physical world as a physical instruction which is signed and then delivered. Also, physical notes that represent value will not be able to move into the digital world as they rely on physical form to effect a transfer of value. Instructions in the digital world will have to be digital.

From this we can see that ultimately a generic payment instruction in a digital form could replace many, if not all, of its physical counterparts. In the future we will simply provide payment. Once authenticated, the electronic payment instruction will be executed. The concept of an electronic wallet is simply a familiar and logical way of providing the means of authentication and payment.

The Future of Electronic Wallets

The electronic wallet is poised to become a personalized portal for each individual. The following are just some of the capabilities individuals will come to expect from their electronic wallet.

- **Online shopping from mobile devices**

  The electronic wallet will be able to facilitate purchasing from mobile phones and PDA's. The poor user input of mobile phone keypads is presently a barrier to mCommerce. The electronic wallet can minimize the number of key clicks required to purchase from these devices by automating the online purchasing process.

- **Price comparison shopping**

  The electronic wallet will allow comparison shopping at any Internet access point. This will be used for online and offline purchasing. It is now possible for a consumer to access price comparison services from a mobile device while shopping at a physical location. This will provide true price transparency and consumer control.

- **Bill Payments**

  The electronic wallet will be able to make bill payments on behalf of the user. This will include scheduling payment intervals for electronic bills and invoices and receiving bill reporting from any Internet access point.

- **Loyalty Redemption**

  The electronic wallet will give consumers realtime reporting of points accrued under loyalty schemes and their conversion entitlements. This will actually promote a convergence of loyalty schemes and may lead to loyalty points becoming fungible with value.

- **Personal Information Access**

  The electronic wallet will become a single access point to all personal information. This will including medical, insurance, motor vehicle, mortgage, superannuation and investment reporting. This is the personal financial portal which we have all been waiting for. This information aggregation will also extend to online auction monitoring and online gaming.

- **Virtual Personal Organizer**

  The electronic wallet will store the user's calendar, contacts, tasks and lists on the network allowing this to be retrieved and updated from any device. This will eliminate the need to hot-sync.

- **Wireless purchasing at physical locations**

  The electronic wallet will allow purchasing in physical stores when the wallet is installed on an infra-red or blue-tooth device. The electronic wallet software will retrieve a persons credit card number from the network and use the native capabilities of the device it is running on to transmit the credit card number to a Point of Sale unit.

- **Pre-emptive Purchasing**

  The electronic wallet performs the purchasing process for the consumer and therefore has a record of purchases made. The electronic wallet will be able to pre-empt purchasing based on habits and actually remind the consumer to make purchases on a regular basis.

- **Device to device Person to Person Payments**

  The electronic wallet will be able to facilitate person to person payments in the physical world. Once installed on a mobile device it will be possible to transfer a payment from one person to another simply by pointing two "wallet-enabled" devices at each other.

- **Customized for Internet Appliances**

  The electronic wallet will have a set of standard features available from any Internet device. However, the wallet will be able to access plug-in functionality specific to the device it is running on. For example, a wallet running on an Internet fridge may be able to detect items which need to be re-stocked and pay for these at the local supermarket, a wallet running on Playstation II may be able to pay for new games that are downloaded and a wallet running on a settop-box may be able to pay the bill for cable or satellite TV.

Conclusion

In addition to the uses of a physical wallet, the electronic wallet needs to satisfy the core requirements of providing payment and authentication in online transactions initiated from any Internet-enabled device. Once this is achieved the electronic wallet will be extended to provide a range of “value-added” services, some of which are outlined above.

The electronic wallet is destined to become the virtual representation of a person on the Internet. Residing on the network, the electronic wallet will be able to be reached from any Internet access point and will become the owner’s authorised agent for eCommerce transactions.