

e-Conveyancing: Challenges and Ambitions

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SUMMARY

Conveyancing is defined as the legal process (preparing the sales deed, mortgage and other related documents) of creating, transferring and dealing with an interest in land, that is a right of ownership in or over land, such as a freehold or leasehold. Presently, the existing system of manual conveyancing causes anxiety and tension to all those who are involved because of its inherent shortcomings. However, it is expected that a comprehensive electronic conveyancing (e-Conveyancing) system which is capable of facilitating electronic conveyancing of documents, online investigation of title, networked communication between the parties, simultaneous completion and registration, etc. would address these limitations by reducing delays, saving time and money and bringing greater transparency.

But, for most jurisdictions the laws relating to property transfer are extremely complicated, and so it is no simple matter to convert paper-based systems built up over several centuries to straightforward electronic processes. So, the author of this paper took up an extensive study about these issues, basing on the input from the initiative taken up by the HM Land Registry of England and Wales and the Dutch Kadaster of the Netherlands on e-Conveyancing. This report is the result of that study and contains a description of those issues, such as customer orientation, institutional and operational changes, data and process security arrangement, services and functionalities to be delivered, business and implementation strategies etc., which need to be addressed to make the dream of e-Conveyancing a reality in any country.

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1. INTRODUCTION

Conveyancing is defined as the legal process (preparing the sales deed, mortgage and other related documents) of creating, transferring and dealing with an interest in land, that is a right of ownership in or over land, such as a freehold or leasehold (HM Land Registry 2003). However, the existing system of manual conveyancing causes anxiety and tension to all those who are involved in conveyancing, due to the involvement of and interdependence between the large numbers of players such as home owners (buyers and sellers), property owning organisations (companies, utilities, pension funds, property developers), lenders – banks and building societies, conveyancers (solicitors, licensed conveyancers and Individual conveyancers), estate agents, surveyors, suppliers to the *conveyancing* industry – existing and potential and government departments and agencies, including Land Registry and local government, in the whole process of conveyancing. The main weaknesses in the existing manual Land Conveyancing system are the long timescale between “handshake” (when an offer is informally accepted) and completion (when the new homeowner receives the keys); the lack of transparency and attendant problems in the chain in terms of delay and uncertainty; the awkwardness and diseconomies in the financial settlements at exchange of contracts and at *completion* of transaction; and the potential for poor conveyancing standards to be adopted – with the present paper-based systems: large numbers of applications lodged with Land Registry prove to be defective. (HM Land Registry 2003).

Whereas, the unprecedented revolutions taking place in the information and communication technology (ICT) are transforming economies and societies across the world. The spread of ICT into homes and offices is affecting the way all stakeholders in the business process communicate with each other and the ways in which they process and store data. Internet is now commonplace and often the norm for business to business and customer/client to business. As the Law Commission and Land Registry of England put it in their joint report on Land Registration (HM Land Registry and Law Commission 1998): “*Dealings with land cannot remain unaffected by the general development of electronic commerce. The public rightly seeks a more expeditious and much less stressful system of dealing with land.*” The joint report again puts it well: “*Nevertheless, however inevitable it may now seem, there is a legitimate public expectation that the change to an electronically based system for dealings with land will produce clear and demonstrable benefits*”.

It is expected that a comprehensive electronic conveyancing (e-Conveyancing) system which is paperless, without *Registration Gap*, with complete *Chain Transparency*, with permanent connection between practitioners and the Land Registry, secured and fraud-resistant and with facility for Simultaneous Money Transfers; and capable of facilitating electronic conveyancing of documents, online investigation of title, networked communication between the parties, simultaneous completion and registration would address the weaknesses of the manual conveyancing system mentioned in the beginning, by reducing delays, saving time and money, bringing greater transparency and certainty and reducing anxiety for people buying and selling property. The proposed system is also expected to provide the property owners better services; transaction intermediaries, such as notaries, conveyancers, estate agents and surveyors new tools to improve the services they offer and to modernise their own internal office procedures; the financial institutions with a more structured system of payments and better services; office IT system suppliers with more business in the form of demand for more software to interface with existing case and office management systems; and the government agencies with greater efficiency in service delivery, payment receipt and information collection. It could be summarised that, introduction of e-Conveyancing can radically reshape the process of land conveyancing, not only to work better but to work in a way which can be handled

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completely electronically giving the customers a more efficient, and a better service (HM Land Registry 2005a).

However, presently, the e-Conveyancing is in its infancy all over the world and the process of planning, piloting and implementing the new electronic system will take several years and is a highly challenging job involving reforming the existing Land Registration Acts and Rules to make it more contemporary and conducive to the way land is used and administered presently, by bringing in legislative changes to legalise the practices of Digital Signature, electronic documents, electronic transfer and execution of deeds and contracts, Electronic Fund Transfer etc.; formation of Virtual Enterprise of all the stakeholders who would have seamless connectivity and access to the information and resources of all these participating organisations limited to the terms and condition as agreed upon; close coordination and active voluntary participation of all the stakeholders; preparation of standards, specifications, terms and conditions, contractual agreements, network access agreements; ensuring interoperability, accessibility, security etc.

Countries like the Netherlands, England & Wales are at the forefront of e-Conveyancing. These Governments have undertaken wide-ranging programmes of legislative change to ensure that the law can meet the needs of today's property markets. Many e-Conveyancing services have already been made operational and many are in the developing and testing mode. Learning from the experience of these pioneers would help in getting an insight into the complexities and difficulties of implementing a system like this. So, to start with, I reviewed various literatures available, which gives insight into the latest developments taking place in England & Wales and the Netherlands related to e-Conveyancing. Secondly, I visited the Head Office of Dutch Cadastre, the Land Registry and Mapping Agency (Kadaster) of the Netherlands in Apeldoorn and the HM Land Registry Head Office of England in London, and had detailed discussion with the personnel involved in the development of e-Conveyancing system in those organizations. Thirdly, I made use of the inputs I received from my earlier visits to Dutch Kadaster office in Arnhem, Municipal Office and Real Estate offices in Enschede in the Netherlands, who are the professional users of the services offered by Dutch Kadaster. The various aspects of design, development and implementation of e-Conveyancing discussed in this report are the outcome the said study.

2. E-CONVEYANCING: THE STORY SO FAR

Though, in both England & Wales and the Netherlands the idea of e-Conveyancing has been evolving over the years, the formal initiative for embracing e-Conveyancing was started more or less at the same time, i.e. in the year 1998. In the case of England & Wales the preliminary proposal was in the form of a joint report by the Law Commission and Land Registry entitled *Land Registration for the Twenty First Century* (HM Land Registry 2005) and in the case of the Netherlands it was in the form of a negotiated agreement with the Notary Board (KNB) for the setting up of e-Conveyancing system in the Netherlands (Leenders 2005). The story of e-Conveyancing, in England & Wales and the Netherlands, so far has been described below.

2.1 Customer Orientation

Though the term e-Conveyancing is being used by both England & Wales and the Netherlands for the programme being implemented to make conveyancing easier, there are striking differences in the basic institutional framework under which the land conveyancing in these countries operates. Notwithstanding the differences in institutional framework, in both England & Wales and the Netherlands the first step towards e-Conveyancing was to study, consult all stakeholders and propose the reform of all the existing legislations related to land registration and conveyancing, in order to give legal sanctity to the process of doing Land Conveyancing through electronic media.

The consultation done by the England & Wales has been unprecedented. Extensive documentation of all the issues, in the most simplistic manner, along with a long list of proposals, suggestion and

questions, have been prepared and sent to almost everyone who have anything to do with land conveyancing in England & Wales, with the request to give their views and suggestions in order to firm up the idea about the model to be built, which meet their needs and aspirations. These also helped them to determine what services would deliver the most early benefit to stakeholders and frame the implementation plan (HM Land Registry 2005). However, the consultation done by the Dutch Cadastre is not limited only to the conceptualisation and implementation of e-Conveyancing programme. That was done more as a part of their ICT Renewal programme of their business strategy to serve the customer better. In this case too, the consultation has been extensive and scientific.

2.2 Existing Platforms

In many senses e-Conveyancing already exist in these countries. They provide the backdrop from which the e-Conveyancing programme has arisen and from which it can continue to develop, on an incremental basis, until the e-Conveyancing vision is fully realised. In both countries, the citizens generally are becoming more familiar with ICT and are increasingly choosing to carry out their business online. Lenders are increasingly marketing their mortgage products, communicating with their customers, conducting their valuations and providing their mortgage offers online. Conveyancers and Real-estate agents too are increasingly making use of the internet to market and to provide their services to clients. The use of case management software is commonplace and specialised online conveyancing services are now available that give clients online access to their cases, keeping them up to date with progress. It is now more commonplace for estate agents to use web technology to market properties for sale, including on-line auctions and sales by tender (HM Land Registry 2003). The Land Registries currently hold, update and operate large databases of property information of the respective countries.

2.3 Approaches Towards e-Conveyancing

Though, the term e-Conveyancing is being used both in England & Wales and the Netherlands for the programme being implemented to make conveyancing easier, there is considerable difference in their conceptual models and the approaches. While the e-Conveyancing model being attempted in England & Wales is more comprehensive and all encompassing, what is being attempted in the Netherlands is presently focussed on making the transaction between the Notaries and the Land Registry to be totally paperless and automated; a pragmatic approach of limiting their targets to a realistic level. Once this target is achieved, these services would be extended to other professional users also. However, this limited implementation of e-Conveyancing is termed as **e-lodgement, e-discharges** etc. in England & Wales. To that extent, what is being attempted in the Netherlands is only a subset of the programme being pursued in England & Wales. It is pertinent to mention here that while the HM Land Registry is the pivot around which all the activities of land conveyancing in England & Wales revolves, that role is played by Notaries in the case of the Netherlands . So any further automation in land conveyancing in the Netherlands comes in the realm of the Notaries and has to be initiated by them.

However, there are some similarities too in their approaches. In both countries, the e-Conveyancing *programme* has an incremental structure. It is being developed and delivered through a portfolio of activities and *projects*, amounting to a series of service improvements that can be built up to realise the full e-Conveyancing *vision*. The aim is to stage a pilot implementation of the full set of services as soon as possible. A *stakeholder*-wide implementation programme could then take many more years to complete. Initially, use of the e-Conveyancing services will be voluntary but there may come a point when use of the service by everyone in the *conveyancing* process will be overwhelmingly in the public interest.

2.4 Proposed e-Conveyancing Models

2.4.1 In England & Wales

The e-Conveyancing process usually begins with the seller instructing real estate agents, probably by using the internet. The real estate agent finds out a buyer and then contacts the buyer's and seller's conveyancers by e-mail. The conveyancer takes the client's instructions. The conveyancer then use case management software to feed in the basic information needed to proceed and obtains details of the title to the property via Direct Links to the Land Registry or the National Land Information Service. Next he or she begins to prepare the conveyancing documents. The seller's conveyancer uses the e-Conveyancing service to transmit the draft *contract* from his case management system to the buyer's conveyancer; the automatic validation checks would compare *contract* data with Land Registry data and electronic messages and would indicate any discrepancies. At this time, a new *notional register* would be built on the system indicating, as each document is prepared, what the new register would look like. There would also be a facility for conveyancers to view Land Registry's *Day List* prior to exchange of contracts, in order to ascertain whether or not there is a pending application which may adversely affect the transaction – for example a bankruptcy notice.

At the *contract* stage, there would be an electronic equivalent of the *contracts*. *Contracts* would be exchanged electronically when buyer's and seller's conveyancers had signalled that agreement had been reached and *contracts* had been signed and released for electronic exchange. The system would provide for automatic exchange of *contracts* relating to all transactions in a property *chain*. For this and other purposes, conveyancers might need to have *electronic signatures* and authentication from a recognised *Certification Authority*. Buyers and sellers might need to empower conveyancers to sign by written authority. A substantive register entry would be made to note the contract; the Register would automatically be frozen and would provide a priority period for the ensuing registration on *completion*. During this period the draft electronic transfer and any draft electronic charges will be agreed and finalised. These documents will then be signed electronically in anticipation of *completion* just as they are in the existing paper system. Shortly before *completion* the parties to the transaction (and all parties in the *chain*) would signal their readiness to complete in accordance with the terms of the *contract*. They will do so probably by using an extension of the *chain* matrix, which will indicate first that all necessary documentation is signed and secondly that all the financial arrangements are in place.

Registration would take place with *completion* of transaction. The changes signalled in the *notional register* would be verified and the new edition of the register would be finalised on the system. All financial obligations, including *Stamp Duty Land Tax* and Land Registry fees as well as payments between buyers, sellers, lenders and conveyancers, would be settled through an *Electronic Funds Transfer* system. With the help of the e-technologies, the amounts of *Stamp Duty Land Tax* and Land Registry fees would be correct in virtually all cases (HM Land Registry 2003).

2.4.2 In The Netherlands

The e-Conveyancing model being attempted in the Netherlands is a more realistic one. Whenever, a Notary wants to create a deed, he logs on to the Web Services of the Land Registry System of Dutch Kadaster, through his computer in his office. The system checks his password and gives him access to the services. He then accesses the template of the concerned deed in the digital library. The deed form templates get displayed on his Monitor. The Notary feeds in all the required information. The software generates an XML and PDF file which looks exactly like the standardised paper deed. After satisfying himself the Notary obtains hard copy printouts. The Notary then gets the deed executed by taking the signatures of all concerned (e.g.: buyers, sellers and witnesses) in his presence. He then signs on the deed and make copy of the same and hand over to the buyer and seller and keep the original with him. The Notary then runs the hashing (SHA-1 hashing algorithms) on the digitally

generated documents (both PDF and XML) which do not contain any signatures. Then he super scribes the hashed files with a Request for Registration of Deed (RRD) message or any other such request messages, as applicable. The Notary once again accesses the web services of the Dutch Kadaster using his password, then encrypts all these files using his Private Key and enters his Digital Signature certifying the execution of the deed and sends the entire document to the Kadaster. (These documents do not contain any physical signature).

On receiving the document, the Kadaster checks whether it has been sent by the authorised person basing on the information from a Trusted Third Party. The Kadaster then decrypts the message, verifies whether that document has been changed, verify the validity of the Private Key and Digital Signature, the identity of the holder of the Private Key used for the Digital Signature etc. with the help of **Asymmetric Cryptography Techniques**. (This technique has been explained in later detail in this report). For an independent check, the document is once again compared with the XML and PDF files created by the Notary initially for executing the deed to ensure that the document has not been tampered with subsequently. If satisfied the Land Registry updates the database, else return the document back to the Notary (Stolk P and Lemmen C 2003; Leenders 2005).

2.5 Legal Issues and Changes Brought In

As stated earlier, for most jurisdictions the laws relating to property transfer are extremely complicated, and so it is not a simple matter to convert paper-based systems built up over several centuries to straightforward electronic processes (UN-ECE 2000). In general, though both England & Wales and the Netherlands have been carrying out financial transactions through electronic media and the Financial Acts approve the electronic transfer of documents, utilisation of Digital Signature etc. for that purpose, as the Land Registration Act and Rules relates to paper documents, 'true copies' on paper, and analogue procedures, the Land Registration Act did not approve the usage of Digital Signature and digital execution and transfer of deeds in land transactions (van der Molen P 2001). So the the Land Registration Act and Rules needed to be amended with legislative provisions to enable the implementation of e-Conveyancing in the form envisaged for the realisation of e-Conveyancing.

However, even after amending all the outstanding legal issues, the e-Conveyancing as envisaged in the Netherlands still requires a written deed of conveyance to be kept by the notary public and an automatically generated electronic copy to be submitted to the registrar. The notary public accepts the liability for any difference between the electronic copy and the original written deed. No electronic document is given compulsive evidence, but the written registration does not have this in the present system either. Therefore the electronic signatures do not affect the existing legal certainty (Louwman 2002). Whereas in the case of England & Wales, by law, all the competent persons are permitted to draw deeds and approach the Land Registry for registration. Further, the registrations in the Land Registry do constitute compulsory evidence. So, it is not enough if a certified copy of the deeds are sent and archived in the Land Registry (Meadows J and Richardson J 2005).

Much of the legal actions exercised by the Notaries in the Netherlands on the signed paper documents are required to be carried out by the Registrars in the Land Registry in England & Wales, basing on the digital deed submitted to them (in the event of implementation of e-Conveyancing). Therefore the Digital Signatures do affect the existing legal certainty. All these added together causes insurmountable problems in the realisation of the e-Conveyancing vision in England & Wales. Though various alternatives are being tried and tested, so far, they are no where near to a satisfactory solution. Till such time, they come out with a secured, legally acceptable, technologically feasible and cheaply and easily adaptable alternative for the present signature system for empowering the wider society with the facility of Digital Signature, the prospects of the implementation of e-Conveyancing as envisaged looks to be doubtful. As it is mentioned in the report of Land registry (HM Land Registry 2005), it also requires passing of secondary legislation (Rules) for receipt by Land Registry of digital deeds.

However, this opportunity of introduction of e-Conveyancing has been used by the HM Land Registry and Law Commission to carry out an exhaustive review of all those legislations related to e-Conveyancing, without limiting the entire exercise to amend only those aspects affecting the implementation of e-Conveyancing, by addressing and plugging the limitations and loop holes in those legislations noticed till then and drafting a fool proof and contemporary legislation in all respect (HM Land Registry and Law Commission 1998; Inland Revenue 2002). Accordingly, the present Land Registration Act 2002 of England and the accompanying rules add more structure to the basic concept of electronic documentation and establish a relationship between the creation of those documents and their use in an e-Conveyancing system (HM Land Registry 2003). The Finance Bill 2003 of England paves the way for stamp duty to be processed simultaneously with land registration (HM Land Registry 2003).

3. E-CONVEYANCING: SECURITY ISSUES

Security is one of the key requirements for all the stages of the conveyancing and registration processes, including the associated electronic funds transfer service. This includes physical, logical and procedural security measures, as well as the security of e-documents or data. Data stored by the component services have to be protected against loss, corruption and access by unauthorized personnel. The e-Conveyancing service must gain the confidence of users by strict adherence to an appropriate level of security. It must be capable of achieving security accreditation through the production of, and demonstrable adherence to, an appropriate accreditation document set that details the risks and countermeasures to be taken. The e-Conveyancing service must strike a balance between security, usability and cost. Access must not be irksome or onerous, but equally security must not be compromised. Security must not be cumbersome and should not reduce usability and scalability. One of the weakest links, as far as the security of e-Conveyancing is concerned, is the e-mail exchanges of documents between different stakeholders from geographically separated locations using internet. Unfortunately, e-mail exchanges on the Internet are almost totally unprotected. e-mail communication in plain text can be intercepted at every intermediate Internet hardware (such as routers) or even on the communication lines where the information passes. This information can be misused in a number of ways (Utimaco Safeware AG 2002). Keeping in view of its importance of the security of documents transmitted via e-mails, various security aspects related to the exchange of documents through e-mails have been discussed below.

3.1 Security Risks of Data and Processes of e-Conveyancing

The risks, the data and processes of e-Conveyancing, would be exposed to can be grouped under the following five categories:

Integrity: The e-Conveyancing service must ensure the integrity of data and messages against accidental or deliberate malicious alteration from the point at which they are sent by the originator to the point at which they are received. Integrity of the service must be demonstrable such that any changes to any data or message between the sender and the recipient can be identified.

Authenticity: The e-Conveyancing service must be capable of identifying and authenticating the buyers' and sellers' conveyancers (there may be several users on each side), each party's lender(s), other Government departments with interfaces to the service, individual conveyancers, Land Registry staffs, anyone else authorized to have access to the service.

Non-repudiation: The service must ensure the integrity, authentication and non-repudiation of data and information exchanged, after any agreed alterations between the parties. No party using any part of the e-Conveyancing service must be able to deny that they had sent or received any document(s), message(s) or data that had been sent or received.

Audit trails: Comprehensive audit trails of all activities that take place within the e-Conveyancing service are required.

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Privacy: The e-Conveyancing service must provide assurances that privacy is maintained in the documents, data, messages and information exchanged via the component services between users and any ancillary parties (such as lenders and clients). It must be capable of ensuring that unauthorized persons cannot read a document even if they gain access to it.

3.2 Countermeasures for e-Conveyancing Security

The solutions based on **Public Key Cryptography** and other access right control measures, it is possible to protect all of these categories of risks as given below (Utimaco Safeware AG 2002):

Integrity: Digital Signature and hash values secure the integrity of information,

Authenticity: Digital Signature, encryption, user login and certificates guarantee the authenticity of the sender,

Non-repudiation: Digital Signature and certificates as well as time-stamps make information or transactions undeniable,

Privacy: privacy of information can be protected through encryption and access rights control.

3.3 Public Key Cryptography (Asymmetric Key Cryptography)

Public Key Cryptography is a form of cryptography which generally allows users to communicate securely without having prior access to a shared secret key, by using a pair of cryptographic keys designated as **Public Key** and **Private Key**, which are related mathematically but it is not possible to deduce the Private Key of a pair from the Public Key. The Private Key is generally kept secret, while the Public Key may be widely distributed. The output of this technique is called a Digital Signature (Wikipedia 2005). There is only one Public Key cryptosystem that is in wide acceptance today: This is called RSA; its named for its inventors Rivest, Shamir and Adelman (Stolk P and Lemmen C 2003); the letters RSA are the initials of their surnames.

3.4 Digital Signature

A Digital Signature is nothing but a method for authenticating digital information, analogous to ordinary physical signatures on paper, implemented using techniques from the field of Public Key Cryptography. The term Digital Signature has also been used as a broader term encompassing both Public Key Digital Signature techniques and Message authentication codes. As per this scheme, the Private Key, which is kept as secret, is used for signing the document and the Public Key, which is freely distributed, is used for verifying the signature (Wikipedia 2005).

3.5 Certificate-based Authentication

As anyone who is in possession of a particular Private Key can produce an identical Digital Signature, the Digital Signatures created using a secret Private Key and then checked using a suitable Public Key proves only to the extent that a particular document was signed with a particular key, but not necessarily by a particular person. But in the case of Certificate-based Authentication, it is assumed that the owner of a particular secret key whose unique ID is saved in the certificate is the person who actually used this key for signing that particular document. So, it is important that the owner of the key protects the secret key assigned to him and do not pass it on to other people. It is also important that no one obtain it illicitly.

3.6 Smart Cards and Key Files

The presently used RSA keys are of 1024 bits. As these 1024 bit hexadecimal numbers are difficult to remember, currently the technologies offer two main ways for "carrying" these secret keys. They are Smart cards and Key Files (Aufreiter 2001). The Smartcards can be compared with small computers which can store data and keys and also execute encryption and signature operations themselves. The key can be stored on a smartcard in such a way that it can never be read by another device, but instead

is only used by the smartcard itself. The data on a smartcard are well protected against unauthorized access from outside, such as electronic measurements or analysis using electron microscopes. Using its built-in "computer", smartcards can identify their authorised owner even without the help of other devices, by checking a PIN or a password that the user enters. If the PIN proves correct, the card will create Digital Signatures for its user. Once the PIN has been saved, it can never again be extracted from the card, and is only used internally by the card itself. The same applies to secret keys. A cost-effective alternative to smartcards are Key Files which usually use a standardized format (PKCS#12). Key files contain one or more secret RSA keys and certificates for a user. The file is encrypted using a PIN or password. Before a user can use the secret key for a signature, they must enter the correct PIN. Although key files are a cheap solution, they do however have a range of disadvantages when it comes to security. As a result, they are only really suitable for providing "unimportant" Digital Signatures. In contrast to smartcards, key files can be copied, so the fact that they have been stolen may not even be noticed. Once copied, the PIN can be found out by trying lots of different combinations. If it is tried on a smartcard, it would lock access after a few attempts. Further, in the case of Key Files, when a signature is being created, the key must be loaded into the computer's RAM in plain text, but on smartcards it always stays on the card.

3.7 Entering and Verifying Digital Signature

For any one to sign a digital document and share with others, he should first acquire a key pair (private and Public Key) and a smart card (or other "secured signature creation device"). The smart card has the private signature key, Public Key and a X.509 v3 certificate, which confirms unequivocally that the key pair belongs to a user, which is issued by a **Trusted Third Party (TTP)**. For entering the Digital Signature the person displays the document to be signed on the monitor, checks the document, get satisfied and decides to enter his Digital Signature; calculates the **Hash Value** ('Message Digest') of the document to be signed. He then uses his smart card and identifies himself using his personal identification number and password. Having identified himself, he clicks on the "sign" (seal). The Smartcard then execute RSA (Asymmetric Cryptography) signature on the hash value and **encrypt** the message digest (hash value) with the Private Key which is stored internally in the smart card and then signs the document. As a result of this encryption the Digital Signature, the current time stamp and the corresponding X.509 v3 certificate are appended to the data, which are being signed. The private (secret) part of a signature key does not leave the Smartcard at any point of time. The public part of a signature key is exported from the Smartcard to the signed message (Wikipedia 2005).

The verification of the signature is done in several steps. First, the signature and the Public Key of the signature key from the certificate are extracted from the delivered signature block of data. Then the file is decrypted using the RSA Public Key. After the decryption with the public part of the signature key, the original hash value can be extracted from the PKCS#1 Block. Then, it is compared with the new calculated hash value of the original file. If both hash values correspond, the **integrity** of the original file is confirmed. On the basis of the time stamp included in the signature block of data, it is checked whether the certificate of the signature key has been valid at the time of the signature (beginning of validity period < time stamp < end of validity period) and its signature is verified with the help of the public part of the key of the certificate issuer (from the root-certificate of the CA). Finally, it is checked whether the delivered certificate, identified by its '**CommonName**', is on the list of the revoked certificates (Certificate Revocation List, CRL). If these checks are positive, the **authenticity** of the original file is confirmed (Bernhard and Kaltschmidt 2003)

3.8 Trusted Third Party (TTP) & Public Key Infrastructure (PKI)

In cryptography, a **Trusted Third Party (TTP)** is an entity which facilitates interactions between two parties who both trust the third party; they use this trust to secure their own interactions. In the case of Digital Signature, the issue of Public Keys must be done in such a way that the Public Key claimed to belong to a person must actually belong to that person. This is commonly done using a trusted third

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party called Public Key Infrastructure (PKI) and the association between the key and user is attested by the operator of the PKI, called a Certificate Authority (CA). So a Public Key Infrastructure is an arrangement which provides for third-party vetting of, and vouching for, user identities. It also allows binding of Public Keys to users. For a good secured messaging application, the Public Key Infrastructure should manage the lifecycle of keys and certificates for all the users through key generation, creation of certificate, creation of certificate revocation list (CRL), maintaining directory browsing facility for collecting certificates etc. This results in the need to support the following standards X.509v3, Certificate Revocation List (CRL) and/or OCSP, LDAP and optionally PKCS#10 and PKCS#7; PKCS#12 and PKCS#11(Wikipedia 2005). There are two independent and reliable Public Key infrastructures (Certification Service Provider (CSP) or Trusted Third Party (TTP)) in the Netherlands namely Pink Roccade Megaplex and Diginotar, authorised to issue Digital Signatures and authenticate the Digital Signatures on the documents. They generate electronic keys and publish electronic certificates in which it is declared that an electronic key is related to a person. (X509v3 format is used for this purpose) after satisfying itself with the identity of the person to whom the key is issued. They also maintain the list of valid signatures and invalid signatures. Every body can check the certificate with the original CSP. The list of invalid signature is called Certificate Revocation List (CRL) (Stolk P and Lemmen C 2003; Leenders 2005).

3.9 Cryptographic Hash Function

A hash function takes a long string (or message) of any length as input and produces a fixed length string as output, sometimes termed a **Message Digest** or a **Digital Fingerprint**. Determination of whether or not any changes have been made to a message (or a file) can be accomplished by comparing message digests calculated before, and after, transmission (or any other event). SHA-1, MD5, and RIPEMD-160 are among the most commonly-used message digest algorithms as of 2005 (Wikipedia 2005). These algorithms are called secure because, for a given algorithm, it is computationally infeasible to find a message that corresponds to a given message digest, or to find two different messages that produce the same message digest. Any changes to a message will, with a very high probability, result in a different message digests. This will result in a verification failure when the secure hash algorithm is used with a Digital Signature algorithm or a keyed-hash message authentication algorithm. (Wikipedia 2005). However, the Federal Information Processing Standard specifies the following four secure hash algorithms - SHA-1, SHA-256, SHA-384, and SHA-512 - for computing a condensed representation of electronic data (message) (NIST 2002).

3.10 Encryption

In cryptography, **encryption** is the process of obscuring information to make it unreadable without special knowledge. Typically, Public-Key techniques of encryption are much more computationally intensive than purely symmetric algorithms (Wikipedia 2005). The public-key cryptography algorithm uses prime factorisation (the factorisation of a number into its constituent primes, also called prime decomposition) as the trapdoor one-way function (Worfram Research Inc 2005).

3.11 CryptoServer

In big organisations like Land Registry, the number of electronic transactions (e.g. sending signed messages: proofs of receipt, proofs of registration etc...) is often so big that the electronic signature with the help of a smart card is not easy to realise. The crypto server is a pragmatic solution in such a situation. The CryptoServer is a Hardware Security Module (HSM) based on a manipulation-proof micro processor which recognises and wards off physical attacks. Security-relevant information as e.g. cryptographic keys and secret data is buffered on a manipulation-proof and non-volatile board memory of the HSM to guarantee the highest level of integrity and confidentiality (Bernhard and Kaltschmidt 2003).

4. E-CONVEYANCING: IMPLEMENTATION STRATEGY

This section describes the component services of e-Conveyancing and how they could be implemented so that the e-Conveyancing vision is realised. The HM Land Registry of England and Wales has carried out extensive consultation (with all the stakeholders) and research to have a clear understanding about their requirements, their concerns. The services explained below are the outcome of this elaborate exercise (Locke 2004).

4.1 Central e-Conveyancing Service

Access to the Service: The e-Conveyancing services should be built in such a way that the users are able to access the service from any site through standard web browsers; users are not required to purchase special software to use the service; and the component parts of the e-Conveyancing service are capable of interfacing with a range of other IT services already known and used by stakeholders.

Network Access Agreements: Access to the Central e-Conveyancing Service should be limited to users under the terms of Network Access Agreements worked out in consultation with all the stakeholders.

Hierarchy of Roles / User profiles: The e-Conveyancing service must have a facility to establish a common functionality for defined roles and establish user profiles (for example, a more limited access for users involved only in preparing conveyancing documents and a higher level of access for those users needing to authenticate documents and conduct conveyancing business).

Management of User Access: User access to the e-Conveyancing service has to be managed and monitored. This should include monitoring both functions and data to which access is allowed or restricted. Users must be able to access all relevant data.

Execution of Transactions: To facilitate the routine activities of the users each transaction done through the e-Conveyancing Services should be allocated a unique identifier; users must be able to create and amend an electronic contract by using either their own document creation software or the facility available in the central service; a mechanism for signaling agreement to any changes, either before, or after signing, is required; there should be some form of document management system in order to enable parties to be sure that they are reviewing the latest version of the contract, highlighting the most recent changes; and an audit trail enabling changes to contract data to be tracked and parties making amendments to be identified, is also required;

Interoperability: The e-Conveyancing service should make optimum use of XML (eXtensible Markup Language) and XML schemas to enable the extraction of relevant information in the digitally signed contract as it is electronically transmitted between the buyer's and seller's conveyancers and should be used to build the Notional Register. The agreed XML schemas should be openly available for any interested parties and should be formally published.

Creation of a Notional Register: The e-Conveyancing Service must be capable of generating a 'Notional Register' showing the proposed new edition of the register, should the transaction proceed to completion with registration. It should indicate those entries to be cancelled from the existing edition of the register and the new entries to be made, as far as, can be ascertained from the data provided. It should identify for cancellation all the register entries relating to the seller(s) (including any legal charge(s)) any other ephemeral register entries (such as cautions and statutory charges).

Mandatory Data: In order to create the new register it is mandatory to supply certain data in conveyancing documents. This should be identified using XML schemas. Mandatory data include the title number, property description and full names of buyer(s) and seller(s). This is the information required to build the Notional Register.

Validation Processes: As the contract is made available by the seller's conveyancer to the buyer's conveyancer through the e-Conveyancing service registration data have to be identified and validated against the existing register to confirm that mandatory data required in e-documents have been supplied; the validation of that data against information held on the register of title and the validation instructions should be sent to the originators of missing or erroneous data, giving details of validation issues for resolution.

Storage of Conveyancing Data: All data and information committed to the Central e-Conveyancing Service relating to transactions is to be held by the service throughout the life of the transaction. All information should remain confidential between the parties to the transaction, except where it interacts with the register of title. This will provide both an audit trail of any changes to the data used to build the Notional Register and also enable the Land Registry to assist with any enquiries at that stage. After completion with registration, data and information on e-Conveyancing transactions should be archived and should be available only to Land Registry.

Message Generation: The Central e-Conveyancing Service must be able to generate messages for users in certain circumstances. These include: validation instructions (together with the reasons), notification of the draft documents, messages to/from the Electronic Fund Transfer service, notification that completion with registration has been effected etc..

Withdrawal from Transactions: The e-Conveyancing service must facilitate immediate withdrawal from a transaction from all parts of the service.

Freezing Register: When contracts are exchanged the Central e-Conveyancing Service should note the existence of the contract (using the XML data extracted from it) on the register of title. At exchange, after the contract is noted, the conveyancer acting for the buyer should have the option to freeze the register pursuant to the contract for sale. The register should be frozen for a specified priority period, or until completion date, whichever is the sooner. The facilities for users to withdraw the freezing of a title upon the mutual agreement of both sides are also needed.

Statement of Accounts and Instructions to EFT Service: The Central e-Conveyancing Service should enable users to create a statement of accounts for each transaction they are dealing with. The end user should enter data details and instructions through their Case Management systems and send to the Central e-Conveyancing Service in the run-up to completion. The Central e-Conveyancing Service should verify the details, calculate the net amounts required to effect all settlements across all transactions in a chain and should confirm the completion statements to users.

Transfer: Once contracts have been exchanged, the temporary file of contract data held by the Land Registry should be deleted and a file of transfer data created. This will comprise the validated contract data and details of the transfer form to be used. The draft transfer should be able to be viewed and accessed by both sides for amendment and/or agreement. Any changes or additions to the transfer data should be automatically re-validated.

Date/Time: All data and messages passing through the Central e-Conveyancing Service must be date and time stamped. The Central e-Conveyancing Service must have the ability to check the chronological order of related data in a transaction, and provide warning messages in the event of items being shown in the incorrect order (such as a lease coming into effect before the transfer to the lessor).

Completion with Registration: The Central e-Conveyancing Service must be capable of achieving completion with registration for all linked transactions as one seamless activity, once users have signalled their readiness to complete on the completion matrix. At completion the register should be unfrozen, the transfer data should be archived, the noting of the contract should be cancelled and the Notional Register should be converted to the new edition of the register. A message to confirm completion and authorize the release of keys should be triggered.

User Training & Information: Effective accredited training methods and materials are required to ensure that all users can confidently conduct their businesses in the e-Conveyancing environment.

Access to Technical IT Help: Effective user support is an important element of the new e-Conveyancing service. Assistance should include provision of a telephone and online helpdesk facility; this should enable users to report technical incidents and receive help and support in diagnosing problems.

Capability to Handle Fluctuation in Volume: The e-Conveyancing service must be capable of handling high volumes and periods of peak activity.

Systems Maintenance: Routine maintenance and upgrades have to be achieved while the service is live, but have to be scheduled at such a time as to minimize any disruption to the service.

Back-up and Disaster Recovery: The disaster recovery tests should be run regularly to ensure business continuity. A disaster recovery plan for the e-Conveyancing service should be developed to ensure that the level of service specified in Network Access Agreements with users can be sustained in the event of the plan being activated.

Technology Upgrades: The e-Conveyancing service should take advantage of advances in technology and maintains a progressive programme of improvement and development.

Change Management Policy: The e-Conveyancing service must be able to adapt to accommodate changes arising from service review.

4.2 Electronic Fund Transfer (EFT) Service

The service should also be capable of processing electronically the range of additional payments associated with house purchases such as conveyancers' and estate agents' fees, Land Registry fees and other disbursements. The EFT service must interface effectively with all associated services so that payments are effected promptly and users are notified automatically of transmission; instructions to pay are capable of change up until the last minute.

4.3 Channel Access Service

Channel services will provide conveyancing practitioners and other property professionals with the means of access to e-Conveyancing services. In their simplest form, they will enable and support access for users and interface with their computers and case management systems.

5. RECOMMENDATIONS

Introducing e-Conveyancing system in any country is a highly complex process which, call for very thorough preparation in order to ensure the successful phased introduction of the new services, wholehearted participation of stakeholders and the legal obligations are met throughout the programme. This can be achieved only if, all the stakeholders have a common understanding about the system being built, the functions each services in the system performs, the order in which each of these services would be introduced etc. All these professionals presently involved in Land Conveyancing have their own preferences, priorities, concerns and limitations. The way they conduct their business also varies considerably. To carry all these stakeholders together, all through the developmental and implementation process of e-Conveyancing, it is to be ensured that they develop confidence in this e-Conveyancing Programme and gain by participating in the process. This explains the importance of having a well thought after Business strategy in the development and implementation e-Conveyancing. A set of general Business Strategy recommendations for the successful design, development and implementation of a new e-Conveyancing system is described below.

5.1 Self Restraint

The existing system of manual conveyancing can cause immense anxiety and tension to everyone concerned, due to the involvement of and interdependence between the large numbers of players in conveyancing. However, it is not prudent to switch from a tried and tested system of conveyancing unless it can be demonstrated that any proposed system will reduce or banish many, if not all, of the negative aspects of the current system. So, before attempting e-Conveyancing in any country, what is thought to be the main problems with the current paper-based system, and how those might be improved by a fully electronic system built on the vast improvements in computer technology that have already taken place in that country should be clearly outlined.

5.2 Step by Step Approach

The whole *programme* should not be introduced as a one-off big-bang affair and instead should be developed and delivered in a modular and incremental basis through a portfolio of activities and *projects*, amounting to a series of service improvements that will build up to implement full e-Conveyancing *vision*. A *stakeholder*-wide implementation of services should be attempted only after staging and proving a pilot implementation of each service under a *programme*.

5.3 Win-Win Situation

A logical extension of the idea of Lemmen, van der Molen and Shennach (2004), shows that the introduction of e-Conveyancing would bring tremendous benefits, to all the *Stakeholders* (along with the Kadaster) too. It would give them new tools to do and manage their job better and cheaper; serve their customers better and offer added services. It would help them to either reduce the human resources or create additional jobs with the existing human resources. It would also facilitate electronic distribution of workload to free resources; irrespective of the geographic location where they are available resulting in reduction of wastage due to idle resources in one place while there is excess workload in another location. So, there is too much for the organisations to gain by participating and contributing in the *programme*. It is a *Win-Win* situation for everyone.

5.4 Human Resource Management

For large organisations like Kadaster, with large number of employees employed on jobs using labour-intensive tools and methodology, this period of change over to the e-Conveyancing is the period when the management has to exercise utmost restraint and compassion towards the employees. During this period employees would be weighed down by the fear of losing the job, pressure to upgrade or acquire new skills, fear of getting disrupted from the existing place of work, fear of fresh and younger employees without sufficient knowledge and experience (according to them) joining the organization and bossing over them, and the chances of them losing their traditional significance and employees from different disciplines getting more prominence etc.. So, the success of the *programme* depends considerably on how the management is able to cope with this difficult transition. However, this is an exercise, worth the pain, in the overall interest of the society.

5.5 Empowerment and Accountability

It is evident by now that there is a need of a strong leadership for ensuring and managing the coordination and cooperation of all the stakeholders for the design, development and implementation of the *programme*. The Land Registry Offices of the countries are expected to play this role. But the Land Registry offices in most of the countries in the present form would not be able to play this highly demanding role. There is a need to empower and equip them with authority, power and liberty to take and implement quick decisions in respect of reengineering and restructuring the Land Registry; making capital investment to follow the best business practices for and while taking this *programme* smoothly and effectively ahead. There is also a need to make them accountable for all such decision taken by them and ensuring that the best accounting practices are in place for doing so

(van der Molen P 2003). It may be noted here that both HM Land Registry and Dutch Kadaster are not financed from the consolidated fund of the respective governments through annual budgets. Instead they are self financed autonomous organizations with clear mandate to serve the society cheaper and better by following the best business and accounting practices. However, keeping in view of the sensitivity of the business they are in, they are still under the remote and sensible control of the government in order to ensure that Land Registry does not take advantage of their monopolistic position and use their business as a source of income. It is a good example for any other country to follow.

5.6 Business Requirements

It is important to ensure that the new e-Conveyancing process and supporting systems successfully meet the business requirements of Land Registry and other *stakeholders*, and is financially and commercially successful. So, organize the development of the e-Conveyancing programme in such a way that the stakeholders can continue their existing business unaffected; ensure that the amount of investment to be done by the stakeholders for the development of e-Conveyancing systems and services and the cost of subsequent operations of the business using those services is much less than the economic benefit they derive in the form of reduction in the cost of operation, manpower and time and increase in the business over the years; ensure that the new e-Conveyancing systems and processes inter-operate smoothly with business operations and services carried out by all the stakeholders outside the direct control of the *programme*; ensure that the participation in the *programme* represent a sound commercial proposition to all suppliers and service providers involved in it's development and delivery so that they would be attracted to voluntarily participate and invest in the development and implementation of e-Conveyancing system (HM Land Registry 2003).

5.7 Business Change

It is important ensure the effective phased introduction of e-conveyancing, and the successful re-engineering of all relevant business processes within Land Registry and in the wider *conveyancing* community. So, ensure that the Land Registry and all *stakeholder* organisations are assisted and guided to manage successfully the changes in their organisational culture, organisational capability, business structure, and operations so that they can easily integrate themselves with the new e-Conveyancing system; ensure that all these transition from the existing organisational culture, organisational capability, business structure and operations to the desired new e-Conveyancing future is planned and managed in a controlled manner, through the phased introduction of elements of the complete *vision*; ensure that all the organisations involved in the e-Conveyancing *programme* are committed to introduce the necessary changes in their respective organisations and are willing to co-operate in the overall change process; ensure that such changes are not introduced as a one-off big-bang affair and are introduced in a modular and incremental basis; ensure that such phased introduction of services and facilities are carefully planned through consultation with all the stakeholders and co-ordinated to meet the requirements of *stakeholders* (HM Land Registry 2003).

5.8 Stakeholder Relationship Management and Governance

It is important ensure that *stakeholders* in e-Conveyancing co-operate on its introduction and operation, and that all formal and informal relationships are managed successfully. So, ensure that the relationships between Land Registry and other bodies are managed through *Network Access Agreements*, Licenses, Service Agreements and other formal instruments; ensure that the Land Registry, in its role as manager of the *programme*, maintain contact with *stakeholders* to their involvement, ensure that all the stakeholders have been clearly explained and "bought in" to the *vision* of e-Conveyancing; ensure that they continue to co-operate in its implementation and in the achievement of all the necessary business change; ensure that the *stakeholders* are informed regularly of all developments and given opportunities to input their requirements and concerns to Land Registry; ensure that a structured relationship is managed with external bodies to involve them as

necessary in decisions on the design, development, and operation of the new services; ensure that the relationships with professional body enable Land Registry to meet its legal obligations; and ensure that the necessary external services and facilities like service from IT industry are available as required for the design, development and operations of the new services (HM Land Registry 2003).

5.9 Legal Issues

It is important to ensure that the land transaction done through e-Conveyancing system is legally acceptable. So, ensure that all the statutory rules, which will be required in order to permit the lawful operation of an electronic conveyancing system, are in place at the appropriate time; and ensure that the system, as it is developed, is legally fit for purpose (HM Land Registry 2003). The opportunity of bringing in massive changes like introduction of e-Conveyancing should be effectively utilised for the cleaning up of the overall system for the common benefit of the society.

5.10 Technical

The *programme* has a major ICT component. So, the successful development and operation of new and modified ICT-based systems and services is at the heart of the achievement of the *vision*. It is also important to ensure that all such technical solutions envisaged will be viable and will be successfully developed, implemented and operated. So, ensure that the land Registry in consultation with the *stakeholders* and other external bodies manage or facilitate the preparation of specification, design, development and implementation of all new and modified ICT-based systems and services; ensure that *programme* authority for all technical issues in the programme are established and made operational; ensure that the ICT systems and services involved will include those developed especially for e-Conveyancing and those currently in use which will require modification; ensure that systems and services which are within Land Registry, under the control of Land registry itself, external contractors and service providers of Land Registry/Kadaster and systems which are within *stakeholder* organisations are included for design, development and implementation; ensure that all such systems and services are integrated into a coherent technical structure that will support the objectives of the *programme* and also ensure that all such systems and services are subjected to the technical requirements and constraints laid down by the *programme* (HM Land Registry 2003).

5.11 Sourcing and Procurement

It is important to ensure that all necessary internal resources, and external provision of services and expertise, are successfully acquired and managed. So, ensure that external contractors have been procured, wherever necessary for the development and delivery of at least some of the services currently identified in the service structure; ensure that all procurement exercises are conducted with due propriety and a high expectation of a successful outcome; ensure that all the activities relating to procurement processes and the subsequent management of the contracts and relationships are established and documented; and ensure that proper choice(s) of supplier or service provider has been done as it is the most critical factors in the overall success of the programme (HM Land Registry 2003).

5.12 IT Service Delivery

It is important to ensure that all the services making up e-Conveyancing is successfully introduced and delivered operationally to the *conveyancing* community. If the e-Conveyancing service is not acceptable to the user at the point of service delivery, the whole service will be deemed a failure. As the various services involved are delivered and used by a variety of organisations, the introduction into service and management of all the services need to be planned, co-ordinated and implemented to provide a seamless service to the end user. It covers the services to be directly managed by Land Registry and all the external services that will constitute to the overall service (HM Land Registry 2003).

5.13 Data & Process Security Issues

The e-Conveyancing service must gain the confidence of users by strict adherence to an appropriate level of security. The e-Conveyancing service must strike a balance between security, usability and cost. Access must not be annoying or time-consuming, but equally security must not be compromised. Security must not be cumbersome and should not reduce usability and scalability.

5.14 Digital Signature

Today using the solutions based on Public Key Cryptography and all other access control mechanisms, it is possible to protect the integrity, authenticity, non-repudiation and privacy of the data and process which jointly form e-Conveyancing service, though, still there is a need to come with a secured, legally acceptable, technologically feasible and cheaply and easily adaptable alternative for the present signature system, for empowering the wider society with the facility of digital signature.

6. CONCLUSION

There is a legitimate public expectation that the change to a comprehensive ICT based system such as e-Conveyancing for dealings with land will produce clear and demonstrable benefits to the society. But all over the world the e-Conveyancing is in its infancy. There is considerable difference in the institutional frame work within with these countries operate and approaches they adopt. As already seen, while in England & Wales an all encompassing view of e-Conveyancing has already been drawn and all the development is being planned towards this goal, where as, in the Netherlands more realistic and immediately achievable targets are being set for implementation. While both have its own merits and demerits, both the developments are heading towards one common goal of bringing in transparency, accountability and efficiency in land dealings by making use of the emerging ICT to serve their customers cheaper and better.

So, there is a need for every country to involve and consult all the stakeholders and other professional bodies, as a first step towards the implementation of e-Conveyancing, to firm up the idea about the model to be built, which meet their needs and aspirations. The result of such exhaustive consultations should form the basis for the legislative reforms, the preparation of the conceptual models and determination of what services would deliver the most early benefit to stakeholders, and framing their implementation plan and the prioritisation of delivery of services to maximise the benefit to the customers in those countries. It should be born in mind all the time that, if the e-Conveyancing service is not acceptable to the user at the point of service delivery, the whole service will be deemed a failure.

REFERENCES

- Aufreiter, R. (2001). Biometrics and Cryptography: White Paper, Utimaco Safeware AG. **2001**.
Bernhard, W. and S. Kaltschmidt (2003). Signature Server: Technical Whitepaper, Utimaco Safeware AG.
HM Land Registry (2003). The Strategy for the Implementation of e-Conveyancing in England and Wales, H M Land Registry.
HM Land Registry (2005). e-Conveyancing: The Story so far, H M Land Registry.
HM Land Registry (2005a). e-Conveyancing: A Land Registry Consultation, H M Land Registry.
HM Land Registry and Law Commission (1998). Land Registration for the Twenty-First Century- A Consultation Document. England, A Joint Law Commission & H M Land Registry Report.
Inland Revenue (2002). Modernising Stamp Duty on land and buildings in the UK: A consultative Document., Inland Revenue.
Leenders, G. (2005). Visit and Discussion on 12th July, Dutch Kadaster.

Lemmen, C., P. van der Molen, et al. (2004). e-Land Administration: An International Seminar in Innsbruck. TS5 – e-Land Administration and e-Government: 3rd FIG Regional Conference, Jakarta, Indonesia.

Locke, C. (2004). Defining the service: e-Conveyancing, HM Land Registry.

Louwman, W. (2002). Future electronic registration of deeds in the Netherlands. Conference of Land Registrars, Dublin, FIG OICRF.

Meadows J and Richardson J (2005). Visit and Discussion on 22nd July. London, HM Land Registry.

NIST (2002). Specifications for the Secure Hash Standard: FIPS Publication 180-2, National Institute of Standards and Technology (NIST).

Stolk P and Lemmen C (2003). Technical Aspects of Electronics Conveyancing. TS5 e-Government Aspects of Land, 2nd FIG Regional Conference, Marakech, Morocco.

UN-ECE (2000). Study on Key Aspects of Land Registration and Cadastral Legislation. London, UN ECE Working Party on Land Administration,.

Utimaco Safeware AG (2002). Secure E-mail: SafeGuard Sign&Crypt for Outlook/Notes, Utimaco Safeware AG. **2005**.

van der Molen P (2001). Data Communication: A Lifeline between Land Administration Organizations and Society. International Conference FIG Working Week 2001, Seoul, Korea, OICRF.

van der Molen P (2003). Six Proven Models for Change. FIG Working Week and 125th Anniversary of FIG, 13-17 April, Paris, OICRF.

Wikipedia (2005). Digital signature: From Wikipedia, The Free Encyclopedia., Wikipedia Foundation, Inc. **2005**.

Worfram Research Inc (2005). RSA Encryption, Worfram Research Inc. **2005**.

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