Access control, payment, and smart cards in libraries

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As networked information services on the Internet continue to grow, so the problem for libraries of controlling access and management of these services increases.

There are three problem areas for libraries:
- computer security with regard to open networks: confidentiality, identification and authentication, and document integrity
- authorisation: who is authorised to do what on which resources?
- cost recovery: libraries will need to develop cost recovery charging mechanisms as the amount of electronic information increases and the costs of electronic licences rise.

Current approaches to networked access to electronic information sources favour user direct access and payment, or institutional site licences. Both methods involve multiple connections and interfaces. The former also requires multiple registration procedures and different payment systems while the latter provides no cost-recovery mechanism for libraries. Moreover both approaches give rise to inflation in information prices. Against this background, smart cards are being introduced in libraries as means of controlling user identity and of electronic payment. But current applications in libraries of campus cards and of public payment cards do not yet integrate all the functionalities required by libraries. The TOLIMAC project aims to meet libraries' requirements in terms of user authentication, authorisation, secure communication and charging mechanism. It has developed a smart card-based management system of networked information services for libraries, providing access control and payment mechanisms. These new functionalities enable libraries to agree a new type of institutional contract with providers, based on actual use of their services. By placing libraries as key intermediaries between users and providers, the TOLIMAC system sets a new electronic information management concept for access control and charging functions.

Introduction

As networked information services on the Internet continue to grow, so the problem for libraries of controlling access and management of these services increases[1]. Management of electronic services in the library environment involves complex and time consuming administration of access to the various electronic resources and managing different charging policies for user categories. Currently, cost recovery is achieved by invoicing or by handling small sums of

money for mediated services, such as online searches or inter-library loans.

Thus, there are three problem areas for libraries:
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- authorisation: who is authorised to do what on which resources?
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Users of networked information services, in turn, have to cope with numerous passwords, different interfaces and evolving pricing models[2] for accessing information services available online. There are also inevitably complex problems for the information providers in terms of controlling access to these services which have a large number of users, and of managing user accounts. In the increasingly global networked information environment, characterised by transactions in information access which involve a multiplicity of actors including users, libraries and providers, existing systems of authentication and authorisation are no more adequate[3]. Regarding payment, many different electronic commerce solutions are being developed to secure payments on the Internet, but their diversity might act as a brake upon their expansion.

This paper provides an overview of different approaches to electronic information access, direct and intermediated, and how access control and payment are achieved in each case. Then it focuses on smart card applications in libraries as means of controlling user identity and/or of electronic payment. It eventually presents the TOLIMAC project, Total Library Management Concept, that is developing a smart card-based management system of networked information services for libraries. The system is intended to meet libraries' requirements in terms of user authentication, authorisation, secure communication and charging mechanism.

Direct access to information resources

With the development of a global network infrastructure and the WWW technology, information providers are using the Internet as the predominant channel for delivering online electronic information services directly to the end user[4]. Various commercial online databases are available through the Internet (e.g. through ChemPort and the Institute for Scientific Information[5]). Access to electronic versions of printed journals, digital document delivery and the supply of individual articles 'on-demand' are also new services provided by publishers to meet user

needs and expectations (e.g. Elsevier's ScienceDirect, Wiley's InterScience, Academic Press IDEAL, ACM, etc.[6]). These services offer significant added value and, therefore, require new business models. Traditional print publishing revenue came from subscriptions and advertising. New Internet publishing models are emerging based on access revenues including individual accesses, document ordering, and site licences.

There are two basic access and payment models[7]:
- the subscription model : users have to subscribe to gain access to specific information sources. It implies user identification and involves a separate off-line payment mechanism;
- the transaction model : users do not need to subscribe and can have selective access to information sources. It can require registration and user identification but may also support unregistered, anonymous users and electronic payment mechanisms.

Users can usually browse the tables of contents free of charge, and sometimes can view abstracts for free as well. When user identification is necessary, access control is most of the time achieved either on basis of IP address in case of institutional site licences, or on basis of combined user ID and password for individual licences.

Different charging models are being applied for subscription-based services and for transaction-based services :
for subscription-based or licence access to electronic journals and databases :
- if there is a current subscription to the paper journal, access to the electronic version might be free (e.g. American Institute of Physics, Institute Of Physics, Royal Society of Chemistry, Springer[8]) or charged. A recent survey[9] reveals that the average charge for electronic access reaches 35% in addition to the institutional paper subscription fee;
- some publishers provide access to electronic journals independently of any paper subscription (e.g. Academic Press, Association for Computing Machinery, American Chemical Society, American Mathematical Society[10]). The subscription fee to the electronic version only varies from 90% of the institutional paper subscription fee up to 65% more[11].

for transaction-based or pay-per-unit services :
- information providers usually require users to register for their services and to use prepaid accounts managed by the providers;

- some services do not require user registration and users are charged on a pay-as-you-go basis through various payment methods. Whether the user remains anonymous or not will depend on the payment system used. It will not be the case for instance, if the user pays with a credit card. Furthermore, electronic payment on the Internet raises the key issue of security. To transmit credit card numbers on the Internet is not secure unless security protocols are being used.

Many different electronic commerce solutions are currently being developed to secure payments on the Internet. There are two types of development for securing online payments: security protocols and proprietary solutions[12].

Security protocols help make electronic commerce as secure as possible while ensuring compatibility (e.g. Secure Sockets Layer (SSL), Secure HTTP, Secure Electronic Transactions (SET)). SSL for instance, reduces the risk of credit card information interception, by means of RSA encryption, but it does not authenticate the parties involved[13]. Therefore SSL does not prevent the use of credit card numbers for illegal purposes by sellers, nor the use of stolen or invalid cards by buyers. To the contrary, SET, a protocol developed by MasterCard, Visa and several partners in the high-tech industry, relies on digital certificates to authenticate buyer and seller to each other. A public key encryption infrastructure allows instant exchange, checking and validation of digital certificates for every Internet transaction.

Proprietary solutions for securing transactions on the Internet are numerous. Let us mention two prevailing approaches and illustrative commercial systems[14]:
- *The payment order approach* involves request to a third party to transfer a specified quantity of funds to a specified recipient. This is the electronic equivalent of cheques, credit cards, etc. The CyberCash system[15], for instance, ensures secure communication of credit card numbers on the Internet by means of encryption. The user's bank must be affiliated to CyberCash, the user must install the CyberCash software on his computer and the seller must support CyberCash electronic payment options. CyberCash authenticates seller and buyer and asks for bank authorisation before confirming the transaction.
- *The token-based approach* implies the use of an electronic purse containing tokens corresponding to cash (i.e. electronic cash or *ecash*). Ecash is used to pay merchants anonymously and directly online. For instance, the Digicash[16] payment software, installed on the customer's computer, creates a file that contains coded information

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indicating how much ecash is available. In such a system, consumers need to purchase tokens from Digicash and merchants must have the complimentary software that can extract or accept ecash from the consumer. Ecash is a true cash replacement: it is anonymous and resides where it is downloaded. Lose the file, and you lose the cash [17].

Many other technically innovative solutions are being developed to secure electronic commerce such as First Virtual[18] that proposes transactions through un-encrypted e-mail, Net Commerce (IBM) that develops integrated payment solutions, SG2-payline[19] that provides electronic purse and real-time authorisations, etc.[20]. The wide number of competing payment systems makes it difficult for merchants to provide every user's preferred method. The providers will usually impose a limited selection on their customers. As an example, the COPINET project[21] has opted for the Digicash system. It has developed an experimental system for an Internet-based document search and delivery service for INSPEC. The system provides a simple subscription-based service and a transaction-based service which allows for anonymous information purchases by means of Digicash, as well as billing and credit card payments for registered users. Users and information providers have to support the Digicash software.

Multiple pricing models[22] and payment systems are major drawbacks of direct access to information services: each provider will impose its pricing policy and payment system but users will certainly not be willing to adhere to all of them. They will probably favour one system and one provider until some standards for electronic commerce clearly arise[23]. Another major drawback of direct access to information services is the necessity for the user to get connected and to register with each provider and publisher services separately and to iterate the search until he finds out what he is looking for. This approach could be compared to a library in which journals are classified on shelves by publishers rather than by subject domains.

Intermediated access

Against this background, new intermediaries emerge who wish to facilitate user access to electronic information services[24]. This tendency is clearly part of the overall re-intermediation process over the Internet, i.e.

'the creation of new value between producers and consumers by exploiting the Internet'[25].

Re-intermediation in the electronic information marketplace is observed in the new services being created on the Internet by commercial intermediaries, educational bodies and libraries.

There are three access models for intermediated services[26] :

- remote gateway server: in this distributed architecture, a remote intermediate server hosts bibliographic data and provides links to the publishers' servers for access to full-text journal articles;
- remote aggregator server: a remote intermediate server hosts bibliographic references as well as full-text journal articles;
- local aggregator server: a local server hosts the journals.

Commercial and educational intermediaries and libraries develop different approaches to service access. However, access control and charging mechanisms remain key issues for all of them.

Commercial and educational intermediaries

New intermediation services for online access to scientific electronic journals are being developed by intermediaries, whether new actors or traditional library partners, such as subscription agents (e.g. Swets, Dawson, Ebsco), secondary information products distributors (e.g. Ovid, SiverPlatter), electronic publishers (e.g. HighWire Press), national document delivery centres (BLDSC's Inside, INIST's Article@INIST service) and new service providers (the originally academic service BIDS, Uncover)[27]. Their aim is to provide online access to a range of electronic resources, ensuring maximal coverage either in terms of publishers and titles, as subscription agents do, or rather in specific subject domains. Most services are intended for libraries, although a few of them are available to end users as well.

Besides these actual information and service providers, national or regional initiatives emerge that aim to provide the academic community with easy and wide access to strategic research and teaching information resources. The National Site Licence Initiative, for instance, entitles all UK universities to freely access electronic versions of four publishers' journals. This Internet service is funded by the UK Higher Education Funding Councils. Still in the UK, MIDAS, the Manchester Information Datasets and Associated Services[28], provides a national research support service specialising in online provision of datasets. The service is funded by the JISC (Joint Information Systems Committee), ESRC (Economic and Social Research Council) and the University of Manchester, and is free for higher education. In Belgium, the Elektron project[29], lead by the Flemish Research Libraries Council and partially funded by the Flemish government, aims to develop a network of electronic information to be accessible throughout Flanders. Available resources include reference and periodicals contents databases connected to the Belgian union catalogues of books and periodicals. An electronic document delivery service is to be integrated. The project plans to set up a system for user identification based on LDAP (Lightweight Directory Access Protocol) as well as mechanisms for accounting from institution to institution, and from institution to user.

For both commercial services and educational initiatives, access control is achieved by usual means, i.e. on basis of IP address or of user name and password. The charging models consist of institutional site licences for libraries' access and pay-per-unit in case of end-user access, by credit card or prepaid account. Exactly as in the case of direct access to information resources, the latter transaction-based model presents the drawback for end users of multiple payment methods.

In the site licence model, access control and authorisation management rely on the libraries. This becomes increasingly critical for libraries as distributed access points to electronic information services continue to grow[30]: access through institutional passwords and IP address provides no guarantee on the user identity; personal passwords are hardly manageable on a very large scale, for large numbers of users and large numbers of services; IP address filtering does not allow users to access electronic information services from off-campus since their computers do not have the institution's network number; and it does not permit finer levels of distinction among members of the community. In order to meet the libraries' requirements in terms of access control, some intermediaries start providing management facilities for libraries to control user access to their services (e.g. SilverPlatter, ATHENS3 project for BIDS [31]). Besides access control, the other major concern of libraries is the integration with the library local resources of the new electronic services provided by the commercial intermediaries.

Library intermediaries

Libraries are aware of their key intermediary role in the electronic information marketplace as:

- privileged and knowledgeable actor between users and information providers;
- information mediator, providing guidelines and easy access to resources;
- price moderator and site licence negotiator for contract conditions that match their usage's and means[32].

Consequently, they participate in the overall re-intermediation process on the Internet by developing new tools and electronic services that meet user needs in information searching and make electronic information access easier[33]. A number of library projects, funded under national and European programmes, aim to overcome the shortcomings of direct access and of commercial intermediaries by providing a one-stop access point to comprehensive, multi-publisher and multi-provider information resources, with varying levels of resources integration.

Some projects rather focus on controlling and managing access to distributed information services, i.e. simplifying registration procedures

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such as PRIDE. The PRIDE project[34] aims at developing a broker service to support the identification and delivery of information services. It is intended to provide a unified source of both library-based and networked service descriptions as well as support for user registration, authentication and authorisation for service access, and cost recovery. Other systems concentrate on integrating electronic information resources and services, i.e. simplifying search and retrieval such as UNIVERSE and DECOMATE II. The UNIVERSE project[35] aims to provide a 'logical union catalogue' to deliver library services in specific subject domains. Services include large-scale transparent multi-database search, multi-media document delivery, Inter-Library Loans and collaborative cataloguing. Search results are integrated and presented as if a single logical database were being searched, ensuring record de-duplication and merging.

The DECOMATE II project[36] will develop an end-user service which provides access to heterogeneous information resources in economics, distributed over different libraries in Europe, using a single interface. Users will have access to distributed resources in a specific domain through a single interface. Access management and accountability facilities will be investigated. Finally, the CANDLE project[37] addresses both issues of controlling access to information resources and integrated search and retrieval. It will develop library mediated access to electronic journals by using the CaseLibrary digital resource management system. It will provide access control and rights management functions, as well as a single interface to different services. Resources such as an electronic journal service, the online catalogue and networked CD-ROMs, are grouped into resource groups for users who will be given unit accounts for various time periods.

All of these systems aim to provide, to varying degrees, networked information management functions, such as access control, resources management, single interface to distributed resources and integration of results. Very few of them, however, address the critical issue of cost recovery from users. Yet the budget allocated by libraries to electronic information services is under severe pressure as the amount of electronic information increases, the costs of electronic licences rise and as more users demand desktop access (so the necessary workstation and networking infrastructure has to be provided, which is expensive for institutions). Library and university budgets are not increasing to meet these demands and they are certainly not keeping pace with inflation in document prices.

It is, therefore, crucial for libraries to find new financial resources or to develop cost recovery charging mechanisms[38]. Libraries need to define new information policies which can be modulated and self-

supporting, in order to attract new services and become 'one-stop' providers of digital knowledge to the benefit of users. On the other hand, as the choice of chargeable services increases, it cannot be cost-effective for libraries to continue mediating such services and handling small sums of money on a transactional basis for large numbers of individuals. Consequently, besides access control and services integration functions, automatic payment mechanisms are required which must be integrated in the library management systems. In order to achieve such management functions, smart card technology is being introduced in libraries.

Smart card applications in libraries

A smart card is a plastic card supplied with a microprocessor that is programmable with applications divided into three areas: data carriers, identification, financial[39]. Authentication and electronic payment facilities are key features of smart cards, though not exclusive properties; public key cryptography enables authentication and electronic commerce solutions offer secure online payment mechanisms.

In fact the major benefits of smart cards consist of:
*   providing a highly secure device: smart cards are carried on one's person and protected by a PIN, whereas digital certificates and electronic purse facilities stored on hard drives are vulnerable to hackers;
*   being portable: it allows a user to maintain his digital identity and security, from machine to machine, location to location.[40]

Smart cards can therefore be used in libraries to enhance functions that are currently fulfilled by library cards (i.e. identification, membership details, borrowing status, items on loan, levels of access to facilities, and charges). In addition, smart cards provide access control and payment functions that can be used for a multiplicity of services, including networked information services. Smart cards afford a high level of security and information handling capabilities, superior to magnetic stripe or bar-code cards. But they are much more expensive and their use in libraries should be carefully investigated in order to provide a cost effective means meeting the functionalities required[41].

Smart card applications in libraries can be divided into three groups according to the scope of the overall card applications and the functionalities provided within the library:
*   campus cards used in libraries
*   public payment cards used in libraries
*   authentication card for access to online services

Campus cards

A number of universities around the world are experimenting with the use of smart cards as campus cards[42]. These are intended to be multi-purpose cards providing universities with improved security, electronic purse facilities for university managed outlets and peripheral services, and the cost benefits of a centrally-managed card with costs being shared between departments[43]. The basic applications usually include payment mechanism (e.g. for vending machines, photocopiers, payphones, restaurants, local merchants, etc.), identity (student card), access control (to buildings and seminars, Sports Hall, parking areas) and library card. In general the library functions achieved by campus smart cards are library access, check out of materials, photocopying and fine payment.

In fact, the use of campus smart cards in libraries has wide-ranging implications for current library automation systems. Instead of the usual bar-code-based light pens, a system involving card reader terminals has to be developed to capture the user identity encoded into the smart card, and it has to be integrated into the current circulation system[44]. The expenses incurred through these developments have brought some universities to include the library bar-code as part of the smart card design (e.g. Mondex at York and Nottingham, University of Toronto, University of Waterloo). In this case, the chip is NOT used to fulfil library-specific functions but, in turn, expensive library automation system adaptations are avoided. Consequently, the use of smart cards in libraries will become cost-effective only as campus smart card-based (interfaces to) library automation systems are being developed : these should provide traditional functionalities as well as exploit the advantages of smart cards as devices for access control and electronic payment for networked information services.

Payment cards

Another approach to introducing smart cards in libraries is the use of public payment cards. A number of public libraries are offering facilities which can accept smart card technology. Some of them only provide payment facilities for photocopying services (e.g. the National Library of Australia[45]), while others implement a smart card-based sophisticated system to automate loans, returns, renewals as well as fine payment (e.g. GeacPlus system developed for the Amsterdam Public Library[46]).

In the Netherlands, different pilot experiments are being lead to use the public electronic purses *Chipper* and *Chipknip* for payment in public libraries (in all Zeeland libraries), including charging for Internet access (in Haarlem, Vlissingen and Middelburg), as well as for identification (Vlissingen)[47]. This approach favours the development of interfaces between existing library automation systems and public

payment smart cards, especially as the latter tend to become multi-applications cards. However, international electronic purse developments are very fragmented along national barriers -even inside borders, as is the market for library automation systems. Thus the question arises whether commercial companies will take up the challenge of developing customised interfaces to their library automation systems for some (or all) existing payment cards, or whether they will wait for standards to emerge in terms of electronic commerce and smart card technology.

Card for access to online services

Smart cards can be used to control user access to online information services. User authentication is a major concern of university libraries: they agree site licences with information providers to access online services but for university members only. Access to electronic resources must be controlled. Most of all, it must remain under control. As mentioned before, popular mechanisms that function as filters on IP address or user name / password combinations do not ensure authentication.

Against this background, the Home Office project has investigated the use of student smart cards in a strong authentication process for remote access to online services[48]. It has developed and implemented a protocol whereby a user with a smart card, card reader, PC and Web browser can authenticate himself to a Web server providing sensitive (non public) data. Applications of this technology allowed authorised users to download commercial software, online registration for university courses and getting exam results online. The system provides a strong authentication protocol but does not secure communication and therefore cannot ensure online payments. The next phase in the project development will be the realisation of a three-party authentication service that will enable access to various remote information providers services and will give extra-level of confidentiality to messages.

Conclusion

Although smart cards afford the functionalities required for access control and payment of networked information services, the applications encountered provide only partial solutions in library environments, i.e. either payment or authentication. In order to meet libraries' requirements in terms of user authentication, authorisation, secure communication and charging mechanism, the TOLIMAC project is developing a smart card-based management system of networked information services for libraries.

The TOLIMAC project

TOLIMAC: Total Library Management Concept[49], is a European project funded under the Fourth Framework Programme *Telematics for Libraries* of the Commission of the European Communities (DGXIII)[50]. The aim is to develop a smart card-based system for controlling access to, and managing payment of, electronic products and networked services in a library environment. The system involves three actors: users, libraries and electronic information providers. Library users have remote access through a single Web interface to a range of electronic information services and can pay for them by means of the TOLIMAC smart card. Their electronic purse is always debited in favour of the library that acts as intermediary between users and information providers. Libraries manage, control and adjust user access to electronic resources, whether local or remote, and charge users according to their own information policy. Electronic information providers agree a new type of institutional contract with libraries, based on actual use of their services.

The TOLIMAC project has developed a pilot system which implements two types of applications: an online electronic document delivery service supplied by INIST (France) which includes searching for references, ordering articles and PDF document delivery. Users pay for articles by means of the electronic purse on their TOLIMAC card. The second application is an off-line service enabling users to pay for photocopying machines by means of the TOLIMAC card electronic purse. The pilot system is being tested by library users at Université Libre de Bruxelles, University of Surrey and University College Dublin. TOLIMAC addresses three critical issues for libraries: security in terms of user authentication and confidential communication; authorisation for users to access services; and cost recovery. The use of current standards makes the TOLIMAC system portable world-wide to many different services and applications.

Security

The library environment restricts the techniques that can be used to secure communication between end users, libraries and information providers. Constraints include, for instance, remote access (users want to access library information services remotely from outside the library), insecure computer and network environment (the university network is the training ground of hacker-students and library workstations are regularly tampered with) and unreliable users (trying to avoid payment). Consequently different techniques are used to secure communication between the different entities involved in TOLIMAC. The end user is securely identified to the library-managed system by means of his smart card combined with a PIN. Between the user and the library server,

messages are encrypted to ensure confidentiality and payment security. The cryptographic keys are implemented into the chip (rather than on the unsecured workstation) and on the library server. The smart card is the user's security device: it is portable and enables him to have remote access to electronic information services that are available through TOLIMAC.

Between the library and the information provider, mutual secure identification is ensured. The provider only processes authenticated requests and bills the identified library for the information supplied. The integrity of the electronic documents received from the provider is checked by the library. Regarding payment, the TOLIMAC smart card provides a secure closed-purse system: the interchange of value is encrypted and always occurs between the cardholder and the library. This mechanism guarantees that no electronic cash is lost or created.

Authorisation

The TOLIMAC user management system is customisable. Each library defines its user categories along three criteria:

- access rights to electronic services: libraries grant access to the electronic services to specific categories of users in compliance with the contract conditions agreed with the service provider;
- amount charged for using the service: prices are determined by each library, with differentials for categories of users;
- electronic purse that can be used: each TOLIMAC smart card supports two electronic purses which hold ecash used to pay for services, a personal purse and a departmental purse. The latter is intended for staff members who benefit from departmental accounts to pay for information services.

Cost recovery

TOLIMAC implements a secure payment mechanism that enables libraries to pass the added-value service costs on to their users according to their own information policy. Users in turn are provided with a single and easy payment mechanism to pay for all the information services available through TOLIMAC, whoever is the provider. With TOLIMAC, libraries reinforce their key intermediary role between end users and information providers by achieving a double objective: facilitate user access to electronic services distributed through the Internet and guarantee payment to the providers.

Standards and portability

TOLIMAC resorts to current standards regarding communication (HTTP; TCP/IP), search and retrieval (Z39.50), document order (Item Order),

encryption algorithms (DES, Triple DES), electronic document format (PDF) and user interface (WWW). The system has been conceived to be widely portable to any type of electronic information service, such as bibliographic databases, electronic journals, etc. and to other projects, especially those providing integrated information services through a single Z39.50 interface. The TOLIMAC card can be used for any access control and payment application, such as access to buildings, vending machines, etc. Regarding online payment, as TOLIMAC provides a closed-purse system, it is independent of national currencies and does not rely on bank consortia, on the use of credit cards or on existing electronic purse cards that are used only locally (such as *Mondex* in Great-Britain, *Proton* in Belgium, *Chipper* and *Chipknip* in the Netherlands, etc.). TOLIMAC can be implemented worldwide. It is open to other electronic payment systems since other existing cards can be used to reload the TOLIMAC purse.

Conclusion

Mackenzie Owen and Wiercx[51] describe the future role of libraries in the electronic information society as follows:

"The library pays for the resource (as it does for other library materials, such as books and journals) and makes sure that any use of the resource is restricted to what is allowable under the terms of the licence. This relieves the information provider of having to maintain a contractual and financial relationship with each and every user of the information resource".

But as networked information services on the Internet continue to grow, so the problem for libraries of controlling user access to electronic services and of developing cost-recovery charging mechanisms increases. Current approaches to networked access to electronic information sources favour user direct access and payment, or institutional site licences. Both methods involve multiple connections and interfaces. The former also requires multiple registration procedures and different payment systems while the latter provides no cost-recovery mechanism for libraries. Moreover both approaches give rise to inflation in information prices.

Against this background, smart cards are being introduced in libraries as means of controlling user identity and of electronic payment. But current applications in libraries of campus cards and of public payment cards do not yet integrate all the functionalities required by libraries. The TOLIMAC project aims to meet libraries' requirements in terms of user authentication, authorisation, secure communication and charging mechanism. It has developed a smart card-based management system of networked information services for libraries, providing access control and payment mechanisms.

It integrates three key features:
- customisable user and electronic service management, enabling libraries to control remote access to the networked resources and to charge users;
- user-friendly Web interface and electronic purse, providing users with easy access to, and a single payment method for, a range of information services;
- security and confidentiality of information and financial transactions on public networks, achieved by means of smart cards and encryption techniques.

These new functionalities enable libraries to agree a new type of institutional contract with providers, based on actual use of their services. By placing libraries as key intermediaries between users and providers, the TOLIMAC system sets a new management concept for secure networked access to, and charging of, electronic information sources.

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