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Managing access to a distributed library resource: report from the fifth MODELS workshop

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ABSTRACT

Recommendations for increased resource sharing between libraries have been emerging from a range of sources in recent years. However, the majority of local library management systems currently in use do not inter-operate, so resources are fragmented and there is no unified access. The situation is complicated by organisational and business issues. This was the basis for the fifth MODELS (Moving to Distributed Environment for Library Services) workshop, which explored more effective management of access and resource sharing, and the development of a supporting systems framework. The focus was on public library developments and cross-sectoral cooperation. The paper develops some of the key issues, together with discussion of the emerging *MODELS Information Architecture*.

1. Introduction

This article is based on discussions at the fifth MODELS workshop[1] and further develops the results of earlier workshops.[2] MODELS (Moving to Distributed Environment for Library Services) is a UKOLN (UK Office of Library and Information Networking) initiative, supported by the Joint Information Systems Committee (JISC) of the UK Higher Education Funding Councils and The British Library Research and Innovation Centre (BLRIC). MODELS is working towards a shared view of the future of distributed library services. Over 40 invited delegates attended this workshop which was held in Bath in April 1997; they came from public libraries, academic libraries and information services, and national libraries, as well as from various support services and system vendors.[3] Further information about the format of MODELS workshops can be found in the Appendix.

The paper explores aspects of managing systems access to a distributed library resource. We focus here on public library developments, but this is not to exclude cross-sectoral co-operation, as we believe that the systems issues are generic even if the information and service focus may vary. The aim of the paper is to explore motivations, and to sketch a systems framework which improves access and supports more effective management of resource sharing. Indeed, a part of our contention is that the systems framework which will support resource sharing has many of the same features as that which will support

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other aspects of network information management. This emphasis forms part of a natural progression. The emergence of the Internet has provided a transport mechanism. The Web provides a user access and presentation mechanism. However, it provides shallow support for organisation and management of resources, which in turn presents difficulties for information providers and tedium for information users. This is driving an interest in digital library and network information management issues.

We argue that a major contribution of the library community is to provide organised, well managed services which efficiently connect users to relevant resources. A prerequisite for effective routine management is a consistent, open systems framework which allows libraries and their users to focus on service development and use, without the continual intrusion of specialised technical problems. Current techniques tend to be ad hoc or specialised per resource. Where a library has to manage many thousands of resources, where these are a mixture of local and remote, when they are available under a variety of technical, service and business models, collection management activity needs to be supported by a systems framework.

We are currently formalising a view of what such a framework might look like under the name *MODELS Information Architecture* and we will be promoting this during 1998. Some components of the architecture are presented below.

An important context for this discussion is provided by the recent appearance of *New library: the people's network*,[4] a far reaching report carried out by the Library and Information Commission (LIC) at the request of the Department of Culture, Media and Sport.

2. Managing access to a distributed library resource – background

'Resource sharing' has different meanings depending on the context. It is often used in the context of existing interlibrary loan (ILL) agreements but also in the context of more closely coupled service and organisational arrangements.

It is useful to take a wider perspective. It is common to talk about the 'public library system'. However, public libraries only minimally operate as a 'system': local and individual pressures drive planning and development and the allocation of resources. Nor are they a system in any technical sense: the majority of computer-based library management systems do not interwork with each other, since libraries use a range of proprietary software. From an access point of view, a system-wide framework is in place for ILL, but only parts of the process are automated and performance is variable. Traditional resource sharing is 'shallow'; it is an activity on the margins.

To what extent might public and other libraries of the future operate more fully as a system? Direct end-user access to ILL services is being considered by some authorities; it would benefit from closer automated collaboration to satisfy requests in shorter times. Some services make some sense in a collaborative environment – community information, however it is defined, for example. A reader's information needs in this area are not likely to map neatly onto

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authority boundaries. An approach which allows sensible navigation between authority systems, or which allows them to be presented as a unit, would confer benefit.

At the same time public libraries will be part of other 'systems' of service provision: within a local authority context, with community networking organisations, with other information providers.

These factors suggest that 'resource sharing' may become more important, a suggestion borne out in recent debate. Recommendations for increased resource sharing between libraries have been emerging from a range of sources, including the Aslib Review of public libraries,[5] the APT review commissioned by LINC[6] (Library and Information Co-operation Council), the Anderson Report[7], and the Comedia report on London Libraries[8]. A mixture of resource sharing activities, including some newer ones, might include the following:

- Federated collections. Enlarging the resource available to users: these might be collections of their existing stock, of community information, of local or family history, and so on.
- Effective collection management. Interlending, co-operative withdrawals, touring collections, co-operative selection.
- Co-operative service development and resource provision (acknowledging that co-operation may be more or less, or take different forms). Community information, local government information, heritage/local history collections and catalogues, local government information, business information, …
- Collaborative purchasing/negotiation. Again this could take a number of forms and involve more or less activity (ranging from shared agreements to actual shared management of network infrastructure or information service provision). Aims are to achieve economies of scale and purchasing power.
- Communication, learning and research resources and environments. A wide ranging area which is going to present significant challenges.
- Skills sharing. E.g. shared query and enquiry services. Shared technical or development costs.

At the same time, there are several related pressures for change:

- Political. Local government reorganisation, the expected thrust towards regionalisation on several fronts, closer collaboration between further education and higher education: other topics could also be raised. This is alongside a general discussion of Information Society initiatives.
- Natural convergence of interests. Separate from any directive impulse the changing environment is creating a variety of convergences: with archives and museums, with other providers of public and community information, and so on. There is a significant convergence of interests around education and life-long learning. Scenarios such as the proposed National Grid for Learning will be built from the resources of multiple communities.[9]

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Table 1. Delivery of a range of services

	Book and journal stock	Special collections	'Internet gateway'[10]	'Public' / 'Citizen's' / 'Community' information	Local history	Business information	Life long learning
Motivation for distributed access	Interlibrary Loan.	Research uniqueness.	Comprehensive search.	Cross boundary user requirements.	Research. Cross boundary user requirements.	Cross boundary user requirements. Inward investment.	Shared development. Distance learning.
Partners	Discovery services (Table of contents, abstracting and indexing, etc.). Document supply services. Location services (union catalogues, etc.). Regional Library Systems.	Education and research. Professional associations.	Education and research. Commercial.	Local authorities. Community networking initiatives. Training and Enterprise Councils. Citizens Advice Bureaux. Local organisations.	Local authorities. Archives. Local organisations. Commercial services.	Local authorities. Local businesses. Commercial services.	Higher and further education. Local authorities. Commercial services.
Technical issues							
Content	Largely print literature. Moving to mixed media.	Largely print literature.	Heterogeneous mixed media network resources (services, servers, documents, …).	People; organisations; information systems. Moving to mixed media.	Largely paper-based archives, image collections, etc.	Heterogeneous mixed media services.	Heterogeneous mixed media services.

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Table 1. (cont.)

Metadata ('object')	Catalogues as source of structured metadata. Various stages of completeness.	Catalogues as source of structured metadata. Various stages of completeness.	Varying from unstructured indexes to simple structured records (Dublin Core, WHOIS++ templates)[11].	Proprietary. Often unstructured.	Variable catalogues. Often unstructured.	Catalogues as source of structured metadata. Various stages of completeness.	Variable according to environment and format.
Metadata ('collection')	No agreed approach. Poorly developed.	No agreed approach. Poorly developed.	As above.	Entirely undeveloped.	Entirely undeveloped.	Entirely undeveloped.	Entirely undeveloped.
'well-known' schema	UK MARC.	UK MARC.	Dublin Core; WHOIS++ templates.	US MARC – not widely used.	None.	UK MARC.	Traditional resources in UK MARC. Networked interactive resources undeveloped.
Search and retrieve protocol support	Z39.50 (not widely implemented).	Z39.50 (not widely implemented).	WHOIS++; Z39.50 (neither widely implemented).	Unstructured. Web based. Z39.50 potential.	None.	Z39.50 potential for network-accessible catalogued resources.	Z39.50 potential for network-accessible catalogued resources.
Request support	ART; email; ILL protocol; Z39.50 item order.	Email; ILL protocol; Z39.50 item order.	HTTP 'get'.	HTTP 'get', email (for Web resources).	None.	Email if available.	Depends on format, eg email if available.
Controlled vocabulary	Various subject headings and classification systems in operation.	Various subject headings and classification systems in operation.	Various subject headings and classification systems in operation.	Unlikely.	Various subject headings and classification systems in operation (if at all).	Various subject headings and classifications systems in operation (if at all).	Various subject headings and classifications systems in operation (if at all).

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– Digital information services. Whereas it would be a mistake to suggest that these developments are technologically driven it would also be wrong to underemphasise the influence of networking in providing a material basis for much of what is happening. The networks are creating the 'space' in which certain things become possible, in which previously unimagined connections can be made. The 'logic' of existing libraries is based on multiple copies of individual items distributed to separate stores. The 'logic' of the network is organised around flows of data, around addition at the edges, around collaboration: it provides a basis for thinking about organisations which better support user needs.

Together, these developments suggest more 'deep resource sharing' where there is some realignment of resource and effort around new ways of delivering services (shared cataloguing could be seen as an example of 'deep resource sharing'). Deep resource sharing involves participation in a wider system of provision. An interesting example was given during the workshop by Blunden-Ellis of CALIM (the Consortium of Academic Libraries in Manchester) which is moving towards a framework for seamless access to its collections. He suggested that the point would soon come when they would have to decide whether to actually manage the collective resource as a single collection.

At whatever level 'systems' of service provision operate (a region, a metropolitan area network, national) and whether they are cross sectoral to include libraries of other types, or other agencies, developments will require political and organisational frameworks in which to develop. We are interested in some of the technical issues that will be required to support these developments and some discussion of these follows.

The workshop recognised that a major factor inhibiting technical development was the fragmentation that existed at policy and co-ordinating levels. The public library 'system' currently operates as approximately 200 independent organisations within some weak collaborative frameworks. The current organisational context means that service development and priorities are driven locally, within the broad pattern of expectation set by the legislative requirement. An issue for the future is what type of organisational structures will best deliver new services, services which might best be developed in collaboration. Planning and resource issues need to be addressed at 'systemic' level (whatever the reach of any system) as well as at local level.

New library: the people's network proposes the setting up of a Public Library Networking Agency which may address these issues.

3. The service environment

In this section, we sketch some of the issues surrounding the delivery of services in a distributed environment. Table 1 presents a range of services, loosely arranged on a spectrum moving from well structured, (reasonably) well understood applications on the left, to more heterogeneous, unstructured, mixed

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media applications which present interesting management and systems challenges if they are to be tackled in a consistent, interconnected way.

It is apparent that there is considerable heterogeneity in the current delivery methods of these services. They vary in medium and technical delivery platform, in user interface, in conditions of availability. The focus above is on services generated by libraries themselves. We could easily extend the table to include other services: electronic newspapers and online reference materials, reference databases, newswires and discussion lists, emerging collaborative environments and interactive services. This is the context for which libraries need to prepare.

4. Conduit, content and interconnectedness

A simple view of networked information systems might consider three aspects. The first is the 'conduit' or the network infrastructure itself. The second is the 'content', services like the ones described in the last section. 'Interconnectedness' is the third and perhaps least easy to explain. It could be taken with content, but its importance at this stage of development means that it deserves separate treatment: it is the means by which that vast diversity is woven into an 'information landscape', a service that helpfully connects users and resources.

4.1 Conduit

The network itself (or 'conduit') has provided a material basis for new types of working. Public libraries have variable access to network services[12,13], but it is now generally agreed that there should be a general move to Internet Protocol (IP) based services as a general transport. Given, as we suggest above, that the public libraries do not operate as a 'system' it could be queried whether a 'system-wide' private network is required to support activities. It might be that library requirements are best met by multiple individual connections to the Internet, and that 'system-wide' energies and funding be invested in other activities, such as service development. To answer this question, one needs to start with a view of what applications libraries will want to run and what demands they will place on connections between libraries or between libraries as a group and particular information providers. If such demands turn out to be great, then libraries might benefit from the end-to-end predictable service and managed environment a private network would provide. Additionally, such a private network gives some control over connections to other critical networks. It also gives a more coherent basis for services aimed at the whole of the library sector, whether these are commercial or collaboratively developed services. (Note: 'private' does not mean that such a network is not fully part of the Internet or that data and access cannot pass freely over the edges; it is used to describe the business status of the network.) *New library: the people's network* makes a case for a dedicated public library network.

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4.2 Content

New services and resources ('content') are emerging which benefit from networking to extend access to resources and services or to exchange data[13], but 'interconnected networked services' are in very early stages of development. We have identified some application areas (community information, business information, local history, remote search and request of books and articles, online reference services, and so on). Local authorities have individual priorities, and some have ambitious plans within various contexts of development. But because system wide co-ordination is limited, there is little opportunity for shared planning. How important is distributed seamless access to a wider book and journal resource enabled by a viable discovery and request apparatus of catalogues and other systems? Some think it a central issue; some suggest that it is less important than other developments, the setting up of a shared local history service, for example. The advantages of a 'vision' is that, in a climate of uncertainty, it can set a common aspirational level, it can give purpose and direction, it can act as a basis for lobbying and communication activity. Again, this underlines the importance of *New library: the people's network* in its very first chapter ('Access to knowledge, imagination and learning'), it begins to identify the services of the new library focusing on education and life-long learning, citizen's information, business and the economy, community, and the national library resource.

4.3 Interconnectedness

Take for example, a project group which wishes to discover journal articles and books about Roman Bath. In a well-stocked library, members of the group can scan the shelves. If they want to do a more thorough 'discovery' of material, they can look in the catalogue or they can look in databases on CD-ROM or they might have access to some remote databases over the Internet. Each of these retrieval systems is delivered through a separate interface, searchers may have to move between machines and may have to print out or write down results. Once searchers have discovered a selection of materials, they have to find out where they are. Typically, they will have to return to the catalogue and redo searches for the desired items. If they are in an authority which has an arrangement for reciprocal borrowing with several neighbouring authorities, they will have to redo searches for unfound items in those libraries. Other items might be ordered via the interlibrary loan (ILL) department, where the details will have to be written down again. Then the ILL staff may repeat some of the operations already carried out by the users. Requests may then be sent for materials and the bibliographic details may be rekeyed for transmission.

There is a variety of boundaries – between functions, between users and library – which are not interconnected by systems, and across which data does not flow. The 'connections' are made by human effort: multiple human visits to different systems and multiple transcriptions which waste time and impose barriers to full use.

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Because the focus has been on automating individual library tasks, this type of consideration has not been addressed. The current state of library automation is one in which existing operations or functions have been automated: circulation, ILL or access to reference resources. Such applications have been conceived and developed as functional islands, between which there is intermittent automated communication.[14] This is to miss the the opportunity now posed by the developing technologies, which is not just to automate particular tasks but to automate end-to-end processes in ways that support effective use.

The importance of such integration is becoming clearer as the use of electronic resources increases. The current situation, sketched in the example above, is unsustainable for two reasons: it is wasteful of users' time and it poses growing management problems for libraries who need to move to routine ways of managing collections of electronic resources. We have mentioned access to books and serials. However, users will have access to a much wider range of services making the potential problem much greater.

A piecemeal, experimental approach to electronic resources emphasises local individual and partial solutions and is in danger of de-emphasising the real challenge: the need to move to a common managed framework which allows the selection, organisation, and removal of distributed services with predictable procedures and a high-enough level of 'interconnectedness' to reduce the overhead on users and on library staff.

It is worthwhile saying a few words about why we believe that the development of 'interconnectedness' is central to the future of library services. Consider the three pictures in Figure 1. We can identify three layers: Presentation (where the user accesses resources), Organisation (a library supplied service), and the Resources or content itself. Figure 1(i) shows the situation until recently with multiple different services accessed by different terminals and the services exist independently. Figure 1(ii) shows a recent advance over this where the web provides a unified presentation layer as users access resources through a web browser. However, the organisation of those resources is very shallow, they may

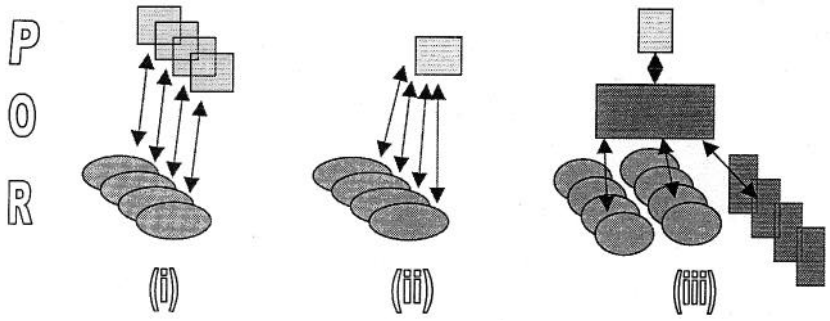

Figure 1. Presentation, Organisation and Resources

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be unified at the 'presentation' layer by being linked from the same web page, but little more. Figure 1(iii) shows the introduction of an intermediate layer, a 'broker', which provides an organised view of resources, which is the active channel for the flows, and which provides 'collection management' functions. It will allow the library to present a consistent and organised view of the available resource to users: this resource may be local or remote. An important feature is that it should move to integrate access to the existing collections (through the catalogue) and new electronic resources. A layer of software, or middleware, which hides underlying differences and which allows the transparent addition of services and resources will provide the basis for this service. It will build on metadata (which describes what is available) and protocols (which allow services to interconnect and data to flow between them). The broker will:

- Allow users to discover the resources which are accessible to them, to support navigation and selection, to provide 'forward knowledge' of what is available and to protect the user from the need to have specialist resource-specific knowledge. (So, in the example of the project group which needs to know what resources are available to them, one scenario might be that there are 'collection or database-level' descriptions which can be used to identify which other services are available. These might be manually-created records or they might also include automatically generated indexes or 'centroids'.)
- Allow users to interact with these services in appropriate ways by delivering the necessary application support for searching, locating, requesting, or delivery of materials. The project group would not want to be bothered with the different user interfaces between the catalogues, the CD-ROMs and the other services. A broker might provide parallel Z39.50 searching which would send a single user query to several databases, and consolidate the results.
- Assist the library control these interactions: authentication, copyright management, charging, management information, etc.
- Assist the flow of data between applications e.g. a record returned in a search may form the basis of a record sent in a document request.
- Save the user's time.

The aim is to provide effective systems support for connecting users to the services and resources they require based on need rather than on the constraints of location, mechanics of interaction, or media.

This 'organisation layer' which allows libraries to broker access to resources and services is critical: it is where much of the vital 'business' of the library will be implemented. Libraries select, acquire, organise and describe. In the electronic world, to be effective, these services will be brokered by software systems which add value; it is what distinguishes the library from other service providers. Of course, this is not to suggest that this will be the only way to investigate resources. Just as now, the existence of the library does not mean that users do not have other information delivery and exchange channels.

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5. A service scenario

This description of what a broker or trading place might actually look like is based on the cumulative experiences of the MODELS workshops which have looked at the issue from a variety of perspectives. This model now actually forms the basis of the AGORA project, being funded under JISC's eLib Programme[15].

5.1 A broker

The schematic in Figure 2 presents a somewhat abstract view of required functions. The term 'information landscape' refers to the view of resources the broker will present. For some time, this may be limited to links from a web page, or searches in a simple database.

The lower layer manages interaction with services. Various services require different modes of interaction and the broker will abstract the mechanics of these interactions. A user may request an item to be delivered but not need to know whether this needs an HTTP 'get', an ILL request, or a note saying to go to the reference collection. Another user may wish to discover some items and should be presented with appropriate available databases and support for effective working across them.

The middle layer provides the services relating to descriptive data, or 'metadata' which allows seamless services to be provided. It might include collection

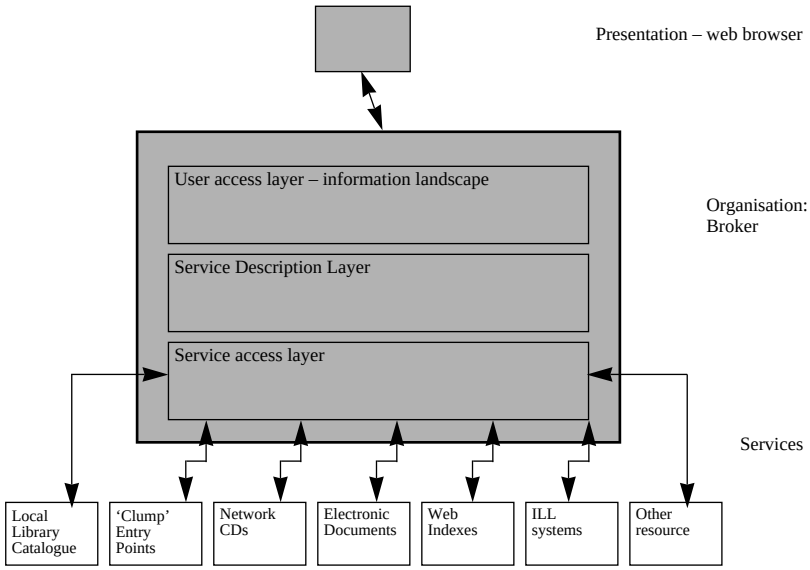

Figure 2. Possible structure of broker service

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descriptions, centroids (database representations based on indexes), and other information about the resources which are accessible. This would be a mixture of data for human users, to assist in selection and use (to support the creation of the 'landscape'), and data for programmers to make best use of the resources. We have little experience of collection description or database representation as existing systems work with more fine-grained objects, individual books, journal articles or images. This support will be valuable for what is sometimes called 'knowledge navigation'. In certain cases it will be more effective to allow users to browse or search representations of resources rather than expecting them to visit individual resources or have prior advance knowledge of all that is available to them. The current eLib subject-based information gateways services, databases of Internet resource descriptions, are examples of a service that may become more common in various contexts. A further step is to provide fuller representation of database content. For example, 'centroids' are inverted index style representations of database content. A search on the centroids provides 'hints' or forward knowledge as to which resources to query. Centroids have been implemented by the ROADS project which supports the eLib subject gateways.

This layer might also include facilities to support semantic interoperability, working across databases with different access points and present results in different formats. So, for example, a user might want to search across library catalogues and directories of Internet services in a consistent way. The broker would have to mediate in such a way as to formulate and execute queries consistently against these databases. It would also need to present the results sensibly back to the user. Or in the future, the user might wish to access an archival service and a library service through the same query and result interface. Increasingly facilities for conversion between formats and access points will have to be provided.

A simple broker might be used to provide clumping facilities. 'Clumps' are aggregations of catalogues enabled by Z39.50 which arose from MODELS workshop 3. Example components that could be integrated in this way are:

- local library catalogue – through Z39.50 service;
- other catalogues – to form the clump;
- CD-ROM services that support the Z39.50 interface – e.g. SilverPlatter's;
- clump entry points that are visible as Z39.50 servers (i.e. a clump represents a virtual database and therefore could be a Z39.50 server);
- other information repositories with Z39.50 or Web interfaces.

Figure 3 shows the functions of the main layers of the 'broker' service. In the user access layer there would be a web gateway to take user input and convert it to an appropriate format, a landscape definition component, and an authentication component. The dynamic interface component adapts the interface to best manage queries and results in the light of the characteristics of the database being interrogated. The landscape definition component would present the services available to the user.

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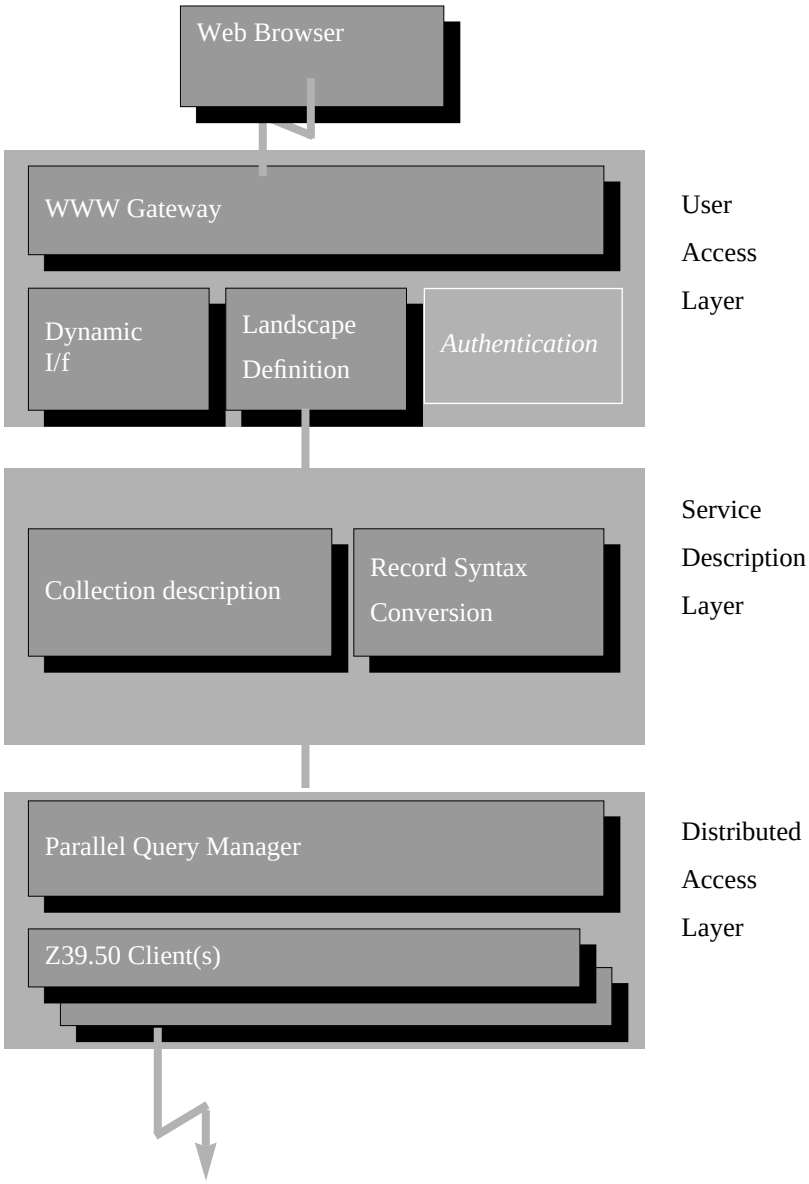

Figure 3. Functions of layers of 'broker' service

In the service description layer, collection descriptions (for which there is no widely agreed representation) and format conversion services are shown. Streams of returned records may be differently structured. Results would have

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to be sensibly collated for presentation. In the distributed access layer, we show a search service based on Z39.50.

A community information system might want to provide access to web sites and to structured databases.

The service might have the following components:

– Z39.50 databases. Structured databases of community information records created by libraries and Dublin core metadata harvested into databases.
– Databases accessed through other protocols. Unstructured web indexes and 'subject gateways' accessible through a directory service protocol.

This gives a mix of services: quality controlled description together with fuller, unstructured access to selected web sites. Figure 4 compares the current situation with a possible future situation. Relevant services can be added, and the mechanics hidden from the user.

6. Notes on implementation and configuration

The discussions have suggested some of the components of a 'three-tier' architecture for managing access to distributed resources. It is important to note that in actual implementation various choices can be made about the richness of the functionality provided and the configuration of the components. A 'broker' might be an individual, an institutional or a national service. It is not necessarily a monolithic application; for convenience we have presented it this way.

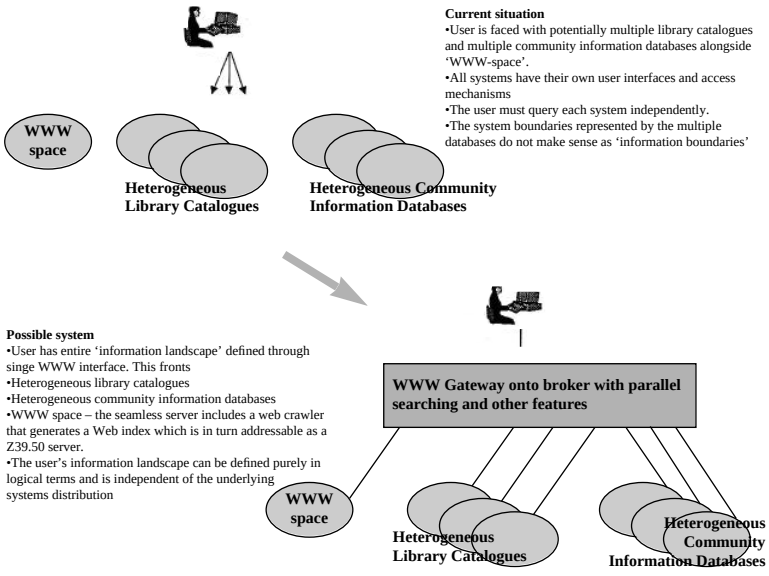

Figure 4. Comparison of current and future situations

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Indeed the emergence of distributed object approaches is likely to encourage separation of the components. The layers we have suggested might be split across machines or sites. The model could be deployed in various business environments. Nor, indeed, is there anything definitive about this particular layering. We believe it is useful: but another approach could be taken to modelling the required components. There are also other functions not discussed here.

Early 'broker' applications are appearing, though they may not be very functionally rich.[16] For example, several applications provide web to Z39.50 gateways which do parallel searching of sources. Within eLib, the EDDIS project will produce a broker with discovery and requesting functions which provides user services transparently over several sources. We believe that such services will tend to offer some of the services we have outlined above but they may be physically assembled in different ways.

7. Conclusion

Much of what we have said is prospective. However the need to develop effective frameworks for managing electronic resources, the demands of collaborative services and the incentives provided by *New library: the people's network* and other reports make this an opportune time to think about how to put in place an infrastructure for flexible network service development.

For the library, there need to be well-understood ways of making resources visible in an 'information landscape'. For the user, it needs to be created in such a way as to guide him or her to relevant resources.

UKOLN is currently preparing a programme which will promote and explain the MODELS Information Architecture. An open approach to 'interconnectedness' will provide the basis for moving the focus of attention from the technical challenges to issues of collection development, user needs, and the policy and practice of new libraries.

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Appendix. MODELS workshop format

The MODELS project is based around a series of workshops addressing significant themes. These involve overlapping concerns but we hope that by progressively working towards a model that incorporates the insights of each workshop, we are helping to contribute to future developments. Five workshops were held in Phase I, with the fifth taking place on 14–15 April 1997.

Participation in MODELS workshops is by invitation only. This ensures the participation of stakeholders and decision makers, as well as technical experts, and enables workable recommendations to be produced. Numbers are also kept low (around 45), so that plenary discussion sessions can take place and consensus can be reached. Usually just one overseas participant is invited, to introduce a different perspective on similar issues. A small planning group is convened for each workshop, which helps to draw up the programme and invitation list. Advice is also sought from other known experts in the field.

MODELS Workshops take place from late morning on the first day to lunchtime on the second. The format is informal, with a series of short presentations firstly to set the scene and then to illustrate the building blocks that are already being put in place as part of the move to distributed environments. The main group is then divided into smaller breakout groups to discuss specific questions and possible solutions, with reporting back to the main group . The final plenary session takes place on the second morning; consolidation of the breakout session results starts to lead to a way forward and a series of actions and recommendations are developed.

Technical consultancy in Phase I was provided by Robin Murray of Fretwell Downing Informatics.

MODELS Phase II started at the beginning of 1998 and includes three further workshops.The project manager is Rosemary Russell.

The MODELS Steering Committee is: Richard Heseltine – Chair (University of Hull), Chris Rusbridge (eLib), Neil Smith (The British Library), Peter Smith (LASER).

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