A Web-based service for real estate provides complex database access controls across multiple organizations.

Zhangxi Lin, Gary D. Anderson, and T.J. Anderson

Web-Based Services for Real Estate: Model and Implementation

E-commerce's impact on real estate is just as significant and multifaceted as in other areas. Its momentum springs from two factors: an increasing population of online customers and increased involvement and investment from the real estate industry (W.A. Muhanna and J.R. Wolf, "The Impact of E-Commerce on the Real Estate Industry: Baen and Guttery Revisited," *J. Real Estate Portfolio Management*, vol. 8, no. 2, 2002, pp. 141-174). One study in 2000 projected that up to 50 percent of prospective US homebuyers would use the Internet to search for new homes within two years, encompassing more than 9 percent of households online, or about six million visitors, to various real estate sites (P.A. Greenberg, "Consumers Edge Toward Web-Based Real Estate," *E-Commerce Times*, 10 April 2000; http://www.ecommercetimes.com/perl/story/2932.html). At the time users accessed real estate sites on an average of 1.8 days per month for a total of 13.9 minutes each day.

The online real estate business' growing demand for application development has created a new market for *application service providers* (ASPs) who develop standardized Internet application systems and information services supporting a specific set of business processes (B. Gillette, "ASPs are the Solution to Overtaxed IT Departments," *Technology*, Apr. 2003, pp. 38-39). Real estate companies and realtors usually purchase an ASP's products as a package that includes Web hosting and data management. This way, ASPs help level the playing field for small e-businesses that formerly could not afford high-cost client-server or customized software.

E-commerce success stories have taught companies that every successful e-business must have a feasible business plan that complies with a model. The questions then become, What business model can an ASP adopt? How can companies transform the model into a Web-based application? How can they choose from the different types of information technologies for a cost-effective application system? CommRex (Commercial Real Estate Exchange, http://www.commrex.com), a Web-based real estate information system, offers a case study in one such service.

E-BUSINESS MODEL

Based in Austin, Texas, Internet Media Works! (IMW, http://www.inetworks.com) specializes in Web-based application implementation, database integration, and Web development and hosting for businesses of all types. IMW's services for real estate businesses include lead generation, and management for real estate transactions, realtor membership, property listings, indices, and auctions. These services are functions of IMW's CommRex.

These services target three types of clients: real estate companies, individual realtors, and proprietary property sellers. All three types are CommRex *service subscribers* (or just *subscribers*). The company's revenues come from application

development, mainly in the form of customization fees for current application packages and subscribers' annual service fees, which vary with their use of services and rental of computing resources. The number of subscribers is perhaps the most important factor in increasing IMW's revenues because most of the online services are standardized. The initial cost of servicing a new subscriber involves setting up a site and configuring profiles to enable the agreed-to features.

The key to better sales is in delivering CommRex services in accordance with a customizable set of *service-level agreements*, which satisfy the various needs of individual real estate companies (A. Susarla, A. Barua, and A.B. Whinston, "Understanding the Service Component of Application Service Provision: An Empirical Analysis of Satisfaction with ASP Services," *MIS Quarterly*, Mar. 2003, pp. 91-123).
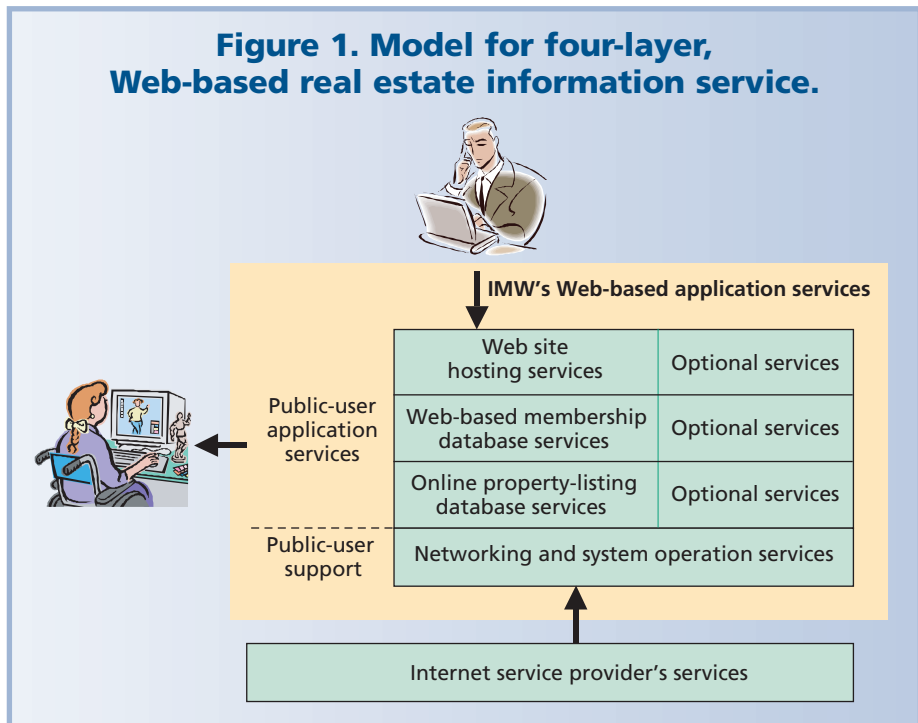
Focusing on Web-based information services, IMW applied an approach driven by its e-business model to design CommRex. This approach led to the adoption of a multiorganization data allocation scheme. These services fall into the four-level structure in Figure 1. The first level is a common Web site structure with HTML and XML (Extensible Markup Language) scripting, Web graphing (a service that generates graphs for publication on a Web site), page styling, and so forth.

The second level is the development and maintenance of Web-based membership databases, which hold contact information for subscribers. Membership databases let IMW applications control subscriber access to some features. This level is an extension of the first level of service.

Membership databases also provide an important service for realtors and real estate companies by letting them advertise themselves, and their products and services. Clearly, a searchable database of realtor information that is accessible from a real estate company's Web site can significantly increase the service's value to the company.

The third level is the development and maintenance of databases for online property listings. This level further extends the services of the first two levels. The prerequisite for this service is a membership database; each of the client company's members owns an account through which they can access the property-listing features. With this level of service, members can post, modify, and delete property

Figure 1. Model for four-layer, Web-based real estate information service.

IMW's Web-based application services

Public-user application services	Web site hosting services	Optional services
	Web-based membership database services	Optional services
	Online property-listing database services	Optional services
Public-user support	Networking and system operation services	

Internet service provider's services

listings from their password-protected account; and the public can search for property listings on the Web. This is the main channel through which realtors can advertise and conduct e-business. Therefore, the property-listing database has a high business value and has become an important service.

The fourth level of service is the networking and system operation service, which lets client companies have personalized Web domains and services set up at other locations that they specify; IMW then provides technical support. The first three levels of services are available in a standardized core package with several advanced options that make up additional customized services.

MANAGING MULTIORGANIZATION DATA FROM DISTRIBUTED WEB SITES

Real estate companies that are successful in e-business commonly share three characteristics (N. Karris and P. Pike, "Entering the E-Commerce Age," *Mortgage Banking*, July 2001, pp. 40-46). They

- offer niche sites that address clear "point of pain" in the process;
- employ business models that work with slow implementation rates and that can sustain profitability even with the addition of only a handful of new customers at a time; and
- offer applications that solve data-integration issues— systems that can connect islands of data and information from different sources or sites.

Figure 2. CommRex data allocation.
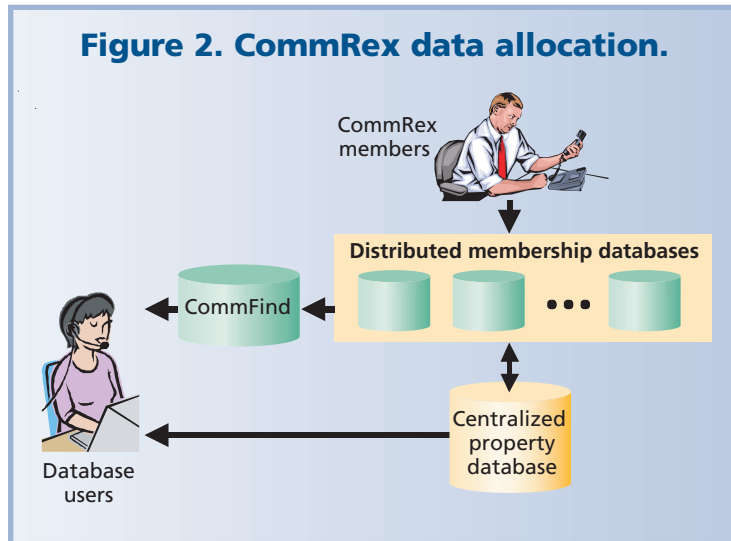
A high priority in CommRex's design was the allocation of data resources for business operation, system performance, and user management. This allocation of data resources considers the primary data distribution as well as how to adjust that distribution to improve response time and availability.

CommRex's original requirements analysis suggested that a multiorganization data management structure would be effective. Later research seemed to indicate that this structure was a decisive factor in the success of CommRex and other systems like it (A. Tamhankar and S. Ram, "Database Fragmentation and Allocation: An Integrated Methodology and Case Study," *IEEE Trans. on Systems, Man, and Cybernetics*, *Part A,* May 1998, pp. 288-305). The multiorganization features of the property-listing database ensure that subscribers can contribute property information to the same database, which strengthens CommRex's information services because the abundance of publicly accessible real estate property data will attract more users. More users, in turn, provide more business value to subscribers. Therefore, multiorganization data management for property-listing information is a common need from real estate information users, the realtors who provide the information, and companies like IMW that bring them together.

In contrast, the requirement for a membership database is different. A membership database controls access to the contents in the property-listing database. Only members of subscribers have authorization to post property listings in CommRex. Even though a multiorganization data management structure could apply to a membership database, the multiple membership databases are distributed in nature.

The requirement for the distributed membership database comes from subscribers. At the first level of service, a subscriber must have a Web site to serve as the entrance point for membership database access. Using an inde-

pendent Web domain with adequate security, a subscriber often requires its stand-alone membership database to remain under its direct control. The membership database's design and the access control it provides determine the usability and effectiveness of a property-listing database for multiple organizations.

In 1999, as the requirement for global reach became prominent, IMW added another centralized multiorganization database, CommFind, to the data allocation scheme. CommFind is a consolidation of the distributed CommRex membership data; it actually serves as a mirror database, integrating all fragments of membership data to provide efficient and convenient realtor information retrievals for users. IMW now automatically updates CommFind every day. Figure 2 shows how we've allocated various types of data to these databases.

COMMREX DESIGN AND IMPLEMENTATION

To use the database structure we just described, CommRex uses six subsystems that map into these databases:

- real estate Web-hosting services (REWS),
- membership database services (MDBS),
- property-listing service system (PLSS),
- public real estate information services (PREIS),
- metadata system (MDS), and
- system maintenance utilities (SMU).

Figure 3 gives a diagram of these subsystems. REWS is a set of basic Web development and hosting services. It is particularly suitable to novice members who have limited knowledge of Internet technologies. Advanced members can request service expansions from REWS to MDBS then to PLSS, which are top-down includable; that is, each more advanced subsystem depends on the lower-level subsystem. In this case, each membership database in MDBS is associated with a specific Web site in REWS that is customizable for the functions and features in the contract between IMW and the subscriber. IMW intends this structure to meet the requirements of different business operations and systems management. It has proved a versatile and flexible framework for functions and processes required by subscribers for different business needs, with reusable application modules throughout the system. In addition, this structure's flexibility permits easy additions or deletions when subscribers leave the CommRex system.

PREIS contains some popular Web-based database access functions for users:

- *Property-listing search.* PLSS supports this function.
- *Membership database search.* CommRex uses REWS

and the mirror database to support this function.

- *Public member sign up*. This function lets any realtor set up an individual account to exploit the advantage of CommRex's membership benefits. This type of account differs from the subscriber member account in that it falls into another service charge category, and IMW charges these users a different rate.
- *Property package download*. This function is for property buyers and realtors who are interested in a package of listings. A realtor posts detailed information about a property that goes into a set of electronic packages housed in a utility called Lead Generation System, which retrieves files from the Package Center in the MDBS. A buyer will download the package(s), after completing a short registration form containing contact information. The system then e-mails the buyer's information to the subscribing realtors for follow-up responses.
- *Property needs posting*. This capability is another buyer-oriented service, letting buyers post descriptions of what they are looking for in the real estate market.
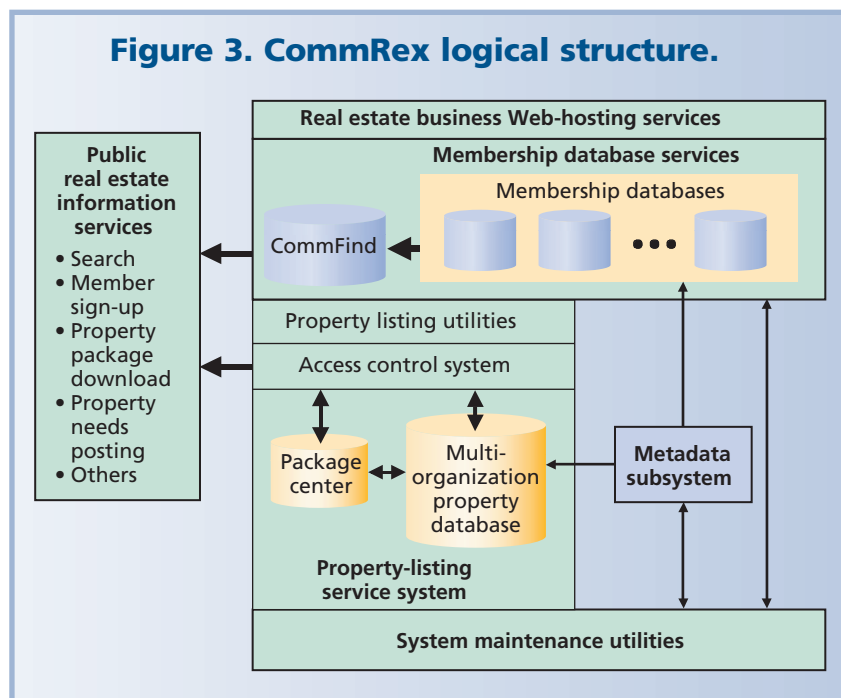
MDS, a typical metadata system, defines and maintains the structure of both the membership database and the property-listing database. A CommRex database administrator can use SMU for regular database maintenance tasks, such as backup, recovery, modification, repair, logging, transaction audit, and data import and export. IMW designed SMU for three types of users: CommRex's system and database administrators, and subscribers' database administrators. Each type of administrative user has different database access privileges. The CommRex system administrator has more extensive privileges than the others, and is the only user authorized to create and configure a new subscriber's site.

Multiorganization database access control

The complexity of access control for a property-listing database lies in the complicated relationships among the types of subscribers. CommRex services must comply with the contracts IMW has with different types of subscribers; each type has various service requirements and constraints. Authorization of subscriber privileges reflects IMW's pricing policy in accordance with differentiated services. The access control system that bridges between MDBS and PLSS plays an important role in IMW's business strategy.

CommRex subscribers are mainly companies and organizations dealing with commercial real estate, such as Certified Commercial Investment Members (CCIMs), CCIM chapters, and regional real estate organizations.

The first type of subscriber comes from the Commercial Investment Real Estate Institute (CIREI), a national organization and a division of the National Association of Realtors (NAR). CIREI's central purpose is to provide education and certification for commercial real estate professionals. There are two types of CIREI members:

- *CCIM designees* have completed the educational requirements, earning them the highest accredited designation in commercial real estate.
- *CCIM candidates* are in the process of taking courses and completing requirements to attain their CCIM designation.

The second type of subscriber belongs to a CCIM chapter. Chapters are local or state associations operating under the CIREI umbrella. They use four levels of membership, the two just listed and two more:

- *Associate*s are real estate professionals who are not CIREI members.
- *Affiliates* are people working in related areas (such as title insurance, lending, appraising, legal services, and building inspection) but who do not work directly in real estate.

A third type of subscriber comes from *regional realtor organizations*, which are associations or chapters of other

Figure 3. CommRex logical structure.

Table 1. Xaccess coding for a property-listing database.

Operation type	Cross-domain search	Data housing	Public access privileges	CCIM access privileges
Global	Default, global cross-server search	Default, save CCIM listings to CCIMNet	Default, open to public	Default, no privileges
Local	L, search local database only	H, save listing to local database only	P, prohibit nonmember input listing	D, designee accessible
Restricted cross-domain	R, restricted server search	S, house candidate listings locally	N, allow public input of needs listings	C, designee and candidate accessible

NAR affiliates whose commercial investment division joins a state-level CommRex site.

These three types of subscriber sets are not independent of each other. Overlaps exist and transfers from these categories to public member status and vice versa are constant. As agreements with each real estate organization vary, controlling the database access privileges of a realtor with multiple memberships becomes a critical issue in system design.

The multiorganization property listing database access policies are as follows:

- Subscriber members can input, modify, or delete property-listing information from their own Web site.
- Property posting is a free service for the members of client companies. Other users can create an account in a public database. Those posting property listings incur a per-listing charge.
- Any individual can post information on property needs from any subscriber's Web site.
- All property-listing information, including needs information, is freely searchable by the public.
- Searching from a chapter site or a realtor organization site only pulls up the listings posted from that site or those listings posted by the members of that site, if posted from another authorized site.
- CCIM designees can post a property listing at any chapter site as well as CIREI's Web site, CCIMNet.
- Some subscribers of each type can further restrict access based on their internal fee-charging policy.

IMW database administrators configure access privileges for the property-listing database in a subscriber's Web site profile, using the cross access (Xaccess) directive. When there is a PLSS database access request from a member of a subscriber, the Access Control System (ACS) checks the subscriber's profile and compares the privileges with the predefined access control tables. If the subscriber has the proper privileges, the system grants the access request.

Xaccess provides two groups of parameters for alternatively predefining search, data housing, and user access permissions; Table 1 lists these parameters. *Local operation* refers to the functions available to Chapter CommRex, a regional version of CommRex for a CCIM chapter, which can only search the relevant property listings in the PLSS database.

System administrators use Xaccess codes in a sort of shorthand, making it easy to manage access privileges. For example, the following subscribers would use the Xaccess codes listed:

CCIMNet, LHND;
Florida CommRex, PD;
Austin CommRex, S; and
CommRex, H.

Some people use several user IDs and have multiple memberships through different subscribers, each of them having different database access privileges. ACS will handle their database access request with the highest privilege set from the affiliated memberships. It also converts the ID to the one in the highest privilege category.

CommRex Performance

CommRex's performance in terms of four characteristics—scalability, portability, operation ability, and availability—is satisfactory, owing to its multiorganization data allocation scheme.

CommRex is scalable, according to a subscriber's customization needs. Both membership and property-listing database services provide optional functional modules for customization, which include a data model extension, optional advanced functions, and other business services. IMW can more easily implement these modules because of the core data model based on PLSS and the use of metadata management.

IMW has customized and ported various versions of CommRex, including

- CCIMNet, the CIREI version;
- Chapter CommRex, a state-level CommRex site licensed to a CCIM chapter that sells membership to participating organizations, such as Florida CommRex and Alabama CommRex;
- Metropolitan CommRex, a version used by the Austin Real Estate Connection, San Antonio Real Estate Connection, and Austin Central Texas CommRex;
- Sold Property Information Services, a service maintaining a collection of sold properties that is searchable for comparable sales data; and
- Vacation Home Exchange Service, a service for short-term house seekers to exchange housing internationally.

CommRex's design is also portable to different network operating systems and platforms. The original implementation is on Unix using CGI (common gateway interface) scripting. It has experienced four major upgrades, beginning in early 1996. Since 2000, IMW has ported CommRex to the Windows platform using Microsoft SQL Server, Internet Information Server, and Cold Fusion scripting. The first customization of Windows-based CommRex was MAR CommRex for the Massachusetts Association of Realtors. That system became operational in 2001.

The operation ability refers to the smoothness of adapting CommRex to IMW's business model. The first challenge in IMW's business is the frequent addition and deletion of subscribers. In the last six years, IMW has set up about 50 membership sites and 10 property-listing sites. Currently, about 25 percent still use CommRex services. January 2002 database statistics indicated that the property-listing database had more than 8,000 listings with a total asset value of $8 billion and commercial leases of 30 million square feet. The number of CommRex members is about 25,000. From 1999 to 2001, monthly hits to the CommRex databases ranged from 25,000 to 60,000.

Methodological Implication

CommRex's system development has been a progressive process with many challenges:

- Potential client companies might not know their requirements well. Usually, requirements are vague and uncertain.
- In mid-1995, the majority of people in real estate had little or no knowledge of the Internet and Web applications. They started to learn from ASPs, and their requirements began evolving, presenting ever-changing system development challenges.
- Various users can have different requirements in terms of system features and functionality. Finding a way to provide a single set of functions for diverse users is key.

Challenges to the ASP's service structure and database design then occur. The system development methodology for CommRex falls into the rapid-prototyping category. Time is the main factor that justifies the benefits from rapid-prototyping methodology; quick time to market of new features helps a company hang on to clients and keeps ASP competitors at bay. Researchers suggest that there is a tradeoff between software quality and the time invested (S.A. Slaughter, D.E. Harter, and M.S. Krisbnan, "Evaluating the Cost of Software Quality," *Comm. ACM*, Aug. 1998, pp. 67-73). Understandably, CommRex was far from perfect at the beginning. The process that caused improvements in CommRex's design and usability was also a process of letting subscribers become familiar with the Internet and CommRex. During this evolutionary process, the multilevel service model and multiorganization data management structure have been proven an effective choice for such an evolutionary process. ■

Zhangxi Lin is an assistant professor of information systems in the Rawls College of Business Administration at Texas Tech University. Contact him at zlin@ba.ttu.edu.

Gary D. Anderson is acting president and chief technical director of Internet Media Works! Contact him at gary@inetworks.com.

T.J. Anderson (29 November 1951 to 9 April 2002) was founder, co-owner, and president of Internet Media Works! She will be missed and always remembered.