



4. WWW browsers and servers are adequate for working with scientific and engineering data, but could be improved by providing better support for foreign language interfaces. Java developed by Sun and recent work by Netscape Communications are a good step in this direction.

In short, WWW is a natural choice for a front end to our layered digital library system. Benefits include a large availability of browsers, servers that allow execution of digital library applications through "cgi-bin" scripts, data serving to heterogeneous clients, visualization on heterogeneous clients with tools such as Cyberview, easy construction of portable interfaces with Forms, and launching of client-side analysis programs through MIME type recognition. On the other hand, working with large amounts of numerical data from scientific and engineering applications presents special challenges which still, by and large, remain open.

5. Conclusion

There is an emerging trend to combine light weight service layers when developing highly integrated, interactive applications. Our light weight approach is designed to integrate service layers and access tools into fully functional digital libraries. The architecture itself is built upon a Low Overhead Object Management (LOOM) layer and a straight forward ATM networking infrastructure. Its simplicity in design and depth in functionality are good examples of the power in integrating light weight, high performance, components for application development. In particular, we have taken a simple, yet powerful, data management paradigm (PTool) and a very flexible networking architecture (ATM) to develop several digital library applications that easily interoperable with the World Wide Web.

The Graz Digital Library Effort

The Graz Digital Library effort is based on an extension of WWW, the "first second generation hypermedia system" Hyper-G. The reason for choosing Hyper-G is that it not only supports all kinds of searches, but allows to define arbitrary scopes for searches, that it supports multilinguality and that, due to its link concept, allows to (a) conduct discussions around any part of any document and (b) allows to customize the data base for personal purposes. For more information on Hyper-G see <http://hyperg.iicm.tu-graz.ac.at>.

Like all digital library efforts the Graz project was confronted with the problem of how to get substantial material as basis for serious experiments. Rather than relying on external support it was decided to use an approach that would pay for itself: Together with a substantial group of publishers (including Meyer, Langenscheidt, BI, Oxford University Press, Academic Press, Addison-Wesley and Springer) a variety of books (mostly reference material of some kind) was or is being prepared for distribution on CD ROM's: this indeed is considered to be a moneymaker. However, the CD ROM software chosen allows to import the material fairly readily into Hyper-G servers. The idea is to market the material not only on CD ROMs (although this is where most of the money is right now) also via Web servers by offering "up to n simultaneous users" licenses, a feature supported by Hyper-G. In addition to thus being able to be able to create a substantial body of material (like a ten volume encyclopedia, an encyclopedia of computer science, standard reference books for various technical disciplines, and a large number of dictionaries) as second approach the electronic dissemination of electronic journals was taken. By now, J.UCS (see http://hyperg.iicm.tu-graz.ac.at/Cjucs_root), the Journal of Universal Computer Science that is published by the Graz group in cooperation with Springer, has established itself as one of the most respected electronic journals. By now other journals have also been contracted, including the physics publication "Few Body Systems" and the "Journal for Microcomputer Applications" published by Academic Press. The Graz group has also started to work on electronic versions of conference proceedings, see e.g. <http://hyperg.iicm.tu-graz.ac.at/Cedmedia> and is creating an archive of general literature and information on Web related matters, see <http://info.websoc.org> for one example.

Thus, Graz is building up a reasonably large repository of electronic information and will continue to do so. Users select a subset of this digital library according to their current wishes. Whenever they perform a search to locate an item of interest the search is carried out only within the scope defined by the user. By exploiting the annotation and link facilities in Hyper-G, documents that cannot be edited by users (as is of course the case with most electronic library material) can still be linked with other material much in the sense of Ted Nelson's classic "transclusion" ideas. This and the fact that the Graz library concept supports all kinds of data formats (from hypertext formats to PostScript with links, to electronic courseware) makes the Graz effort different from most others known to us.

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