HYPER-G

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Serving Hypermedia to the Web with Hyper-G

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Contents

Many of the figures in these course notes have been reproduced with kind permission of Addison-Wesley from the forthcoming book:

HyperWave: The Next Generation Web Solution
Hermann Maurer et al
Addison-Wesley, April 1996, ISBN 0-201-40346-3.

Chapter 1

Introduction to Hyper-G

What is Hyper-G

- Large-scale, multi-user, distributed, *structured*, hypermedia information system.
- Sophisticated Web server environment.
- Initiated 1989 by Hermann Maurer, at Graz University of Technology in Austria.
- Server for Unix (Windows NT soon).
- Serve documents to WWW and Gopher clients.
- Native clients (authoring tools) for Unix and Windows.

References

- Hermann Maurer; *HyperWave: The Next Generation Web Solution*, Addison-Wesley, April 1996. ISBN 0-201-40346-3.
  `http://hyperg.iicm.tu-graz.ac.at/hgbook`
- Udo Flohr; *Hyper-G Organizes the Web*; BYTE, Nov. 1995.
  `http://www.byte.com/art/9511/sec5/art4.htm`
- Dalitz and Heyer; *Hyper-G: Das Internet-Informationssystem der 2. Generation*, dpunkt, Oct. 1995. ISBN 3-920993-14-4.
- Andrews, Kappe, Maurer; *Serving Information to the Web with Hyper-G*; Proc. WWW'95, Apr. 95. `http://www.igd.fhg.de/www/www95/proceedings/papers/105/hgw3.html`
- Andrews, Kappe, Maurer; *Hyper-G: Towards the Next Generation of Network Information Technology*; J.UCS, Apr. 95. `http://hyperg.iicm.tu-graz.ac.at/jucs`

Online Resources

- Software:
  `ftp://ftp.iicm.tu-graz.ac.at/pub/Hyper-G/`
- Online documentation:
  `http://hyperg.iicm.tu-graz.ac.at/hyperg`
  `gopher://hyperg.iicm.tu-graz.ac.at/11hyperg`
  `hyperg://hyperg.iicm.tu-graz.ac.at/hyperg`

History of Hyper-G

mid 89	Project proposed to Austrian Ministry of Science
Jan 90	Project accepted, Phase I (working prototype) begins
Dec 91	Unix Server and Terminal Viewer (vt100) released
Jan 92	TUGinfo, Graz Uni. of. Tech. info system starts service
mid 92	Hyper-G Phase II begins
Dec 92	ESA adopts Hyper-G for Earth Observation GDS
Jun 93	Amadeus alpha (UniInfo) released
May 94	Harmony 0.84 released
Sep 94	Hyper-G presented at ECHT'94, Edinburgh
Dec 94	ESA Project HyGen with Siemens begins (auto link gen.)
Jan 95	J.UCS Vol. 1, No. 1
Apr 95	Hyper-G Talk/Demo at WWW'95, Darmstadt
May 95	Hyper-G Talk/Demo at CHI'95, Denver
Oct 95	First Hyper-G book (Dalitz and Heyer)
Nov 95	"Hyper-G Organizes the Web" article in BYTE
Apr 96	IICM Hyper-G book, Addison-Wesley

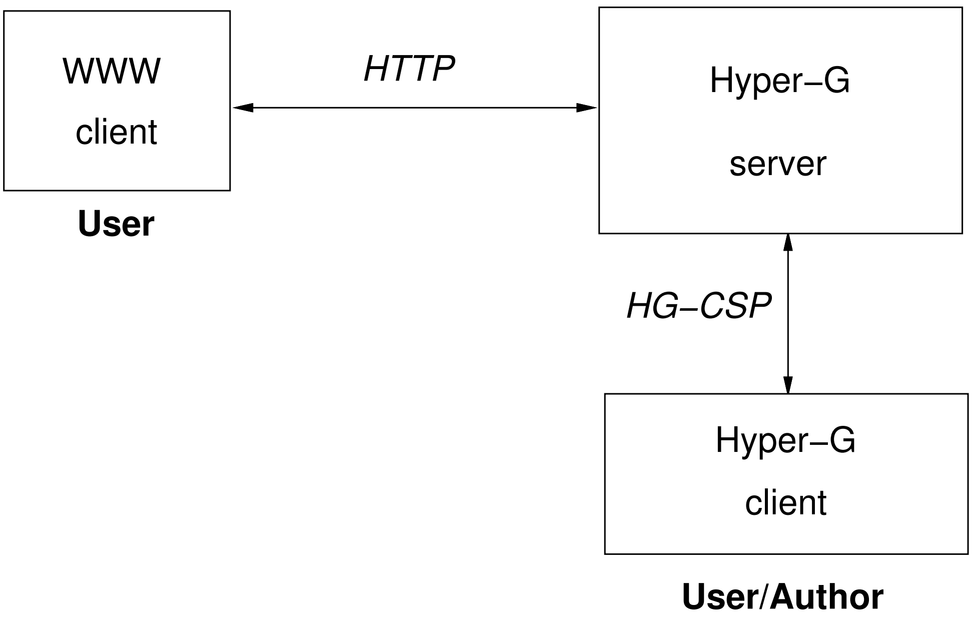

Figure 1.1: Hyper-G as a Web Server.

Hyper-G Client-Server Architecture

- Object server maintains links and attributes.
- Document server stores local documents, serves them to clients, and fetches and *caches* remote documents.
- Full text server maintains full text inverted index (incrementally) and services search requests.
- Server can be accessed by Hyper-G, W3, and Gopher clients (i.e. speaks Hyper-G, HTTP, and Gopher).
- Server can access remote Hyper-G, W3, and Gopher servers.

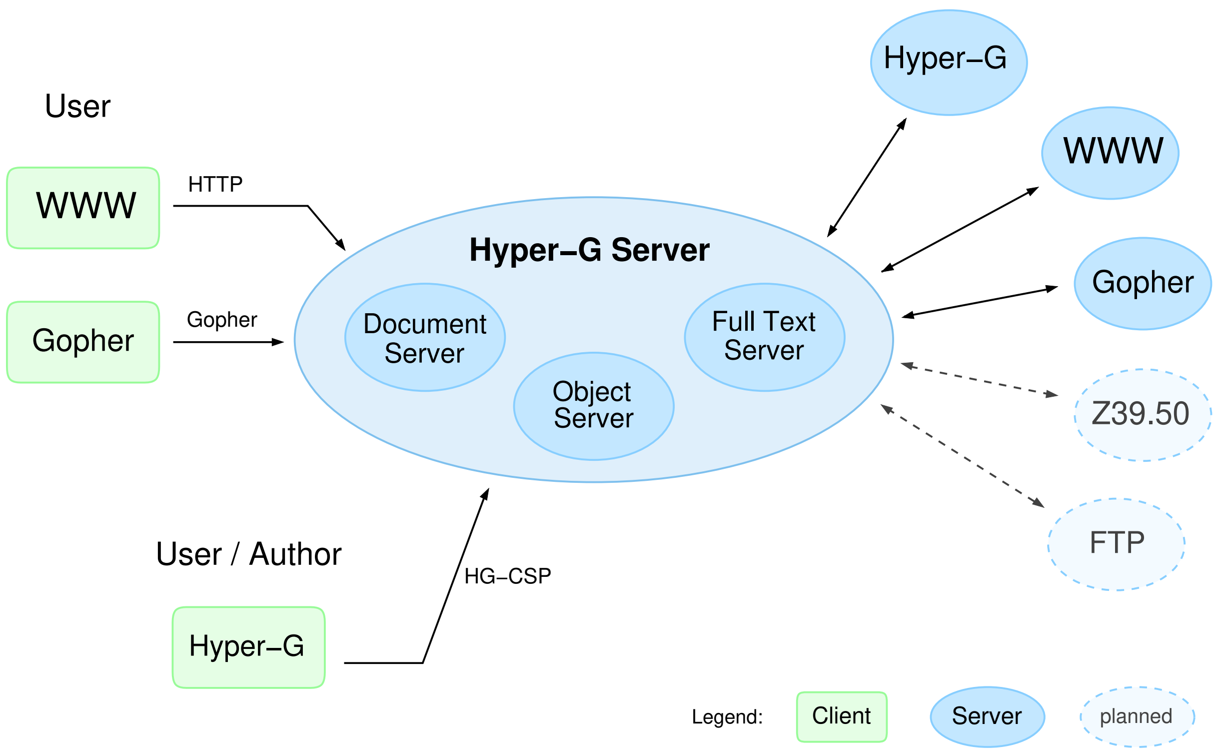

Figure 1.2: The Architecture of Hyper-G.

Hyper-G Data Model

- *Document* – primitive node (text, image, etc.).
- *Collection* – set of other collections and documents (also across server boundaries).
- *Cluster* – special collection of documents:
  - Multimedia cluster: documents of different media, presented simultaneously.
  - Multilingual cluster: documents in multiple languages, most suitable language selected dynamically.
- *Link* – reference from *within* one document to an associated collection, document, or part of document.
- *Sequence* – ordered set of collections, clusters, and documents (guided tour).

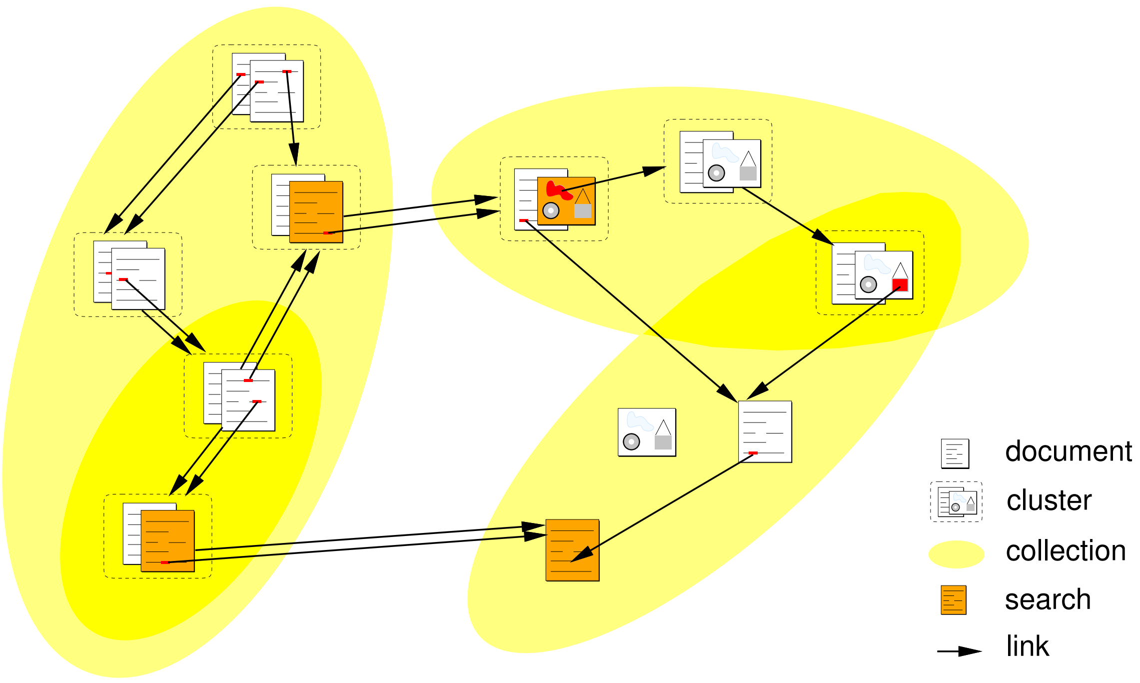

Figure 1.3: The Hyper-G Data Model.

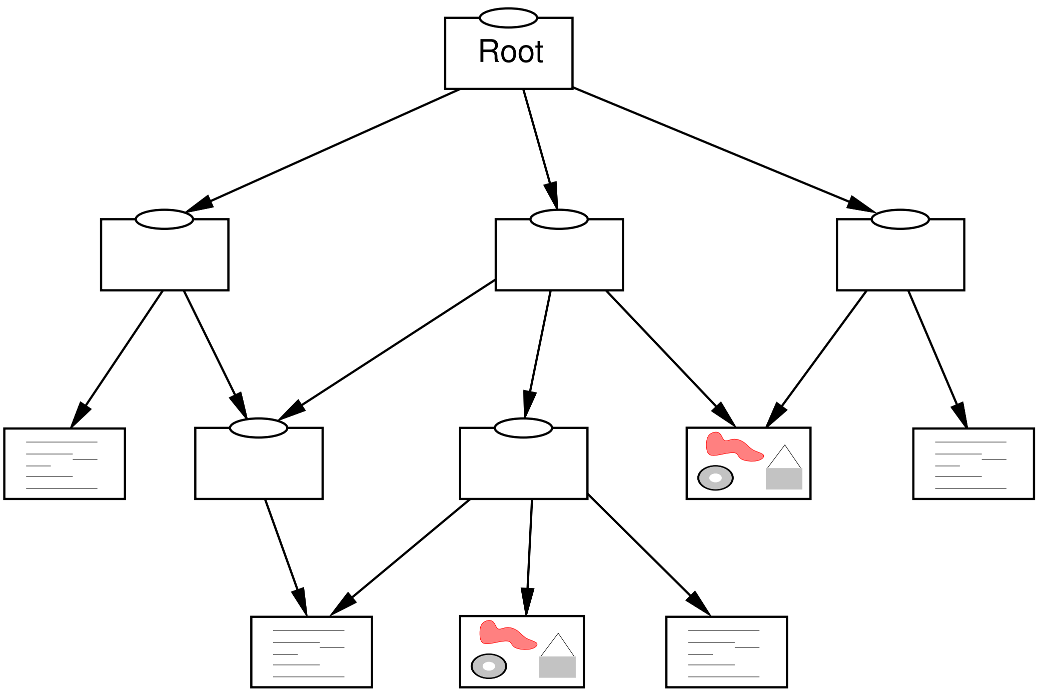

Figure 1.4: The Collection Hierarchy – A Directed Acyclic Graph.

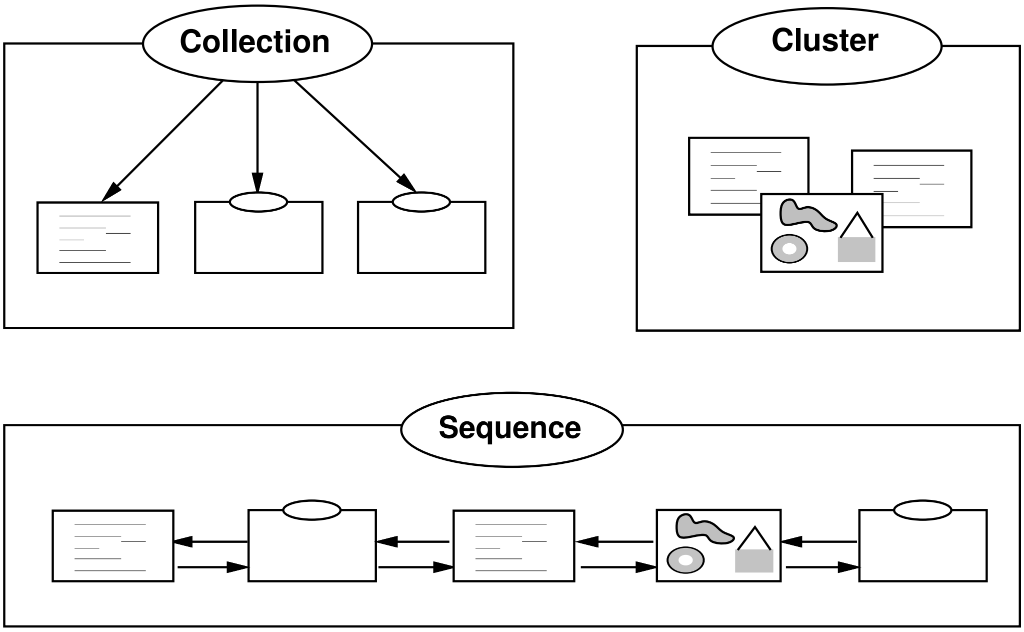

Figure 1.5: Hyper-G Structuring Elements (Collection Types).

Chapter 2

Inside Hyper-G

Hyper-G's Internal Representation

- The Hyper-G server stores *objects* representing documents, collections, link anchors, etc.
- Meta-data are stored as attributes of objects.
- Links and collections are stored as *relations* between objects.

There exists a *class hierarchy* of objects. Attributes are inherited by derived classes.

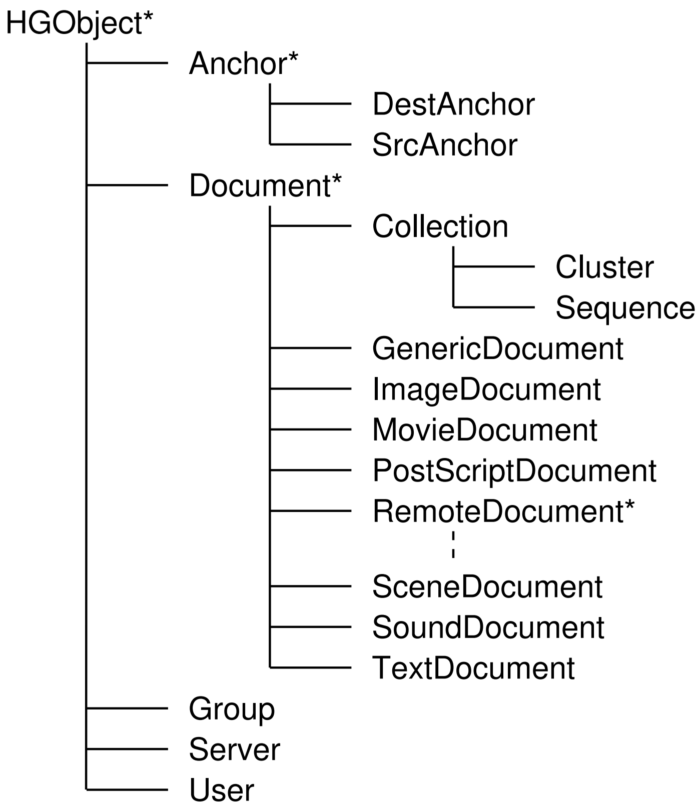

Figure 2.1: Hyper-G's object hierarchy. Subclasses inherit attributes from their parents. Classes marked with an asterisk are abstract base classes, i.e. no instances of such classes can be created.

Object IDs

- Objects have unique id *independent* of physical location (akin to ISBN numbers).
- GOID = Birthplace ID (32-bit IP address) + Object ID (32 bits).
- Object moves → birthplace server maintains link to new location.
- For documents, the Path attribute specifies where the document proper is located.
- Documents and collections can also be given one or more symbolic names (nice, publishable URLs).

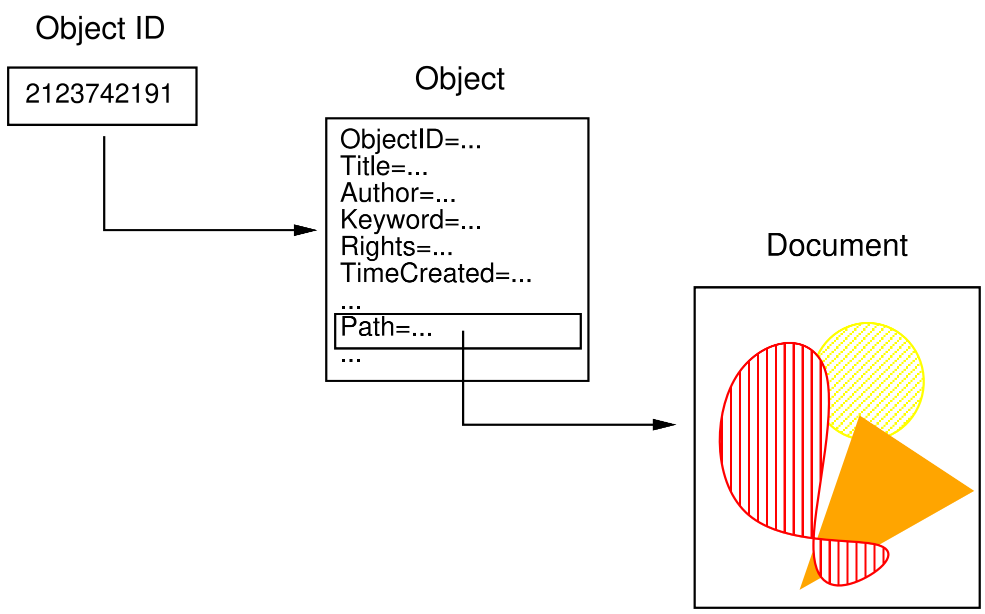

Figure 2.2: Document addressing from ObjectID to object to document.

General Object Attributes

Attribute	*Type*	*Example*
Type		*anchor, document, user, ...*
ObjectID	server	0x0000004d
GOID	synth	0x811b9908 0x000ca010
TimeCreated	server	94/02/01 15:48:22
TimeModified	server	94/11/17 17:08:48
Author	system	kandrews
Keyword	user	Graz Austria
TimeExpire	user	94/12/31 23:59:59
Title	user	en:The City of Graz (Introduction)
Title	user	ge:Die Stadt Graz (Einleitung)
Rights	user	R:g iicm
Sequence	user	10

Document Attributes

Attribute	*Type*	*Example*
DocumentType		*collection, text, image, ...*
Path	server	DC0x0006dbeb 0x000036db
MimeType	user	text/html
Name	user	graz
PresentationHints	user	CollectionHead
Price	system	2

Collection Attributes

Attribute	*Type*	*Example*
CollectionType		*Cluster, Sequence*
Description	user	Meyers Lexikon
License	user	0x0000012c 0x00000003 0x00000014
Subdocs	synth	43820
SortOrder	user	-C

Anchor Attributes

Attribute	*Type*	*Example*
TAnchor		*Src, Dest*
DHint	server	*used for "open links"*
Dest	synth	0x00000070
Position	user	Rect 0.5 0.5 0.55 0.58
LinkType	user	ANNOTATION

Collection Relations

Collection membership is implemented internally as a collection-collection or document-collection relation.

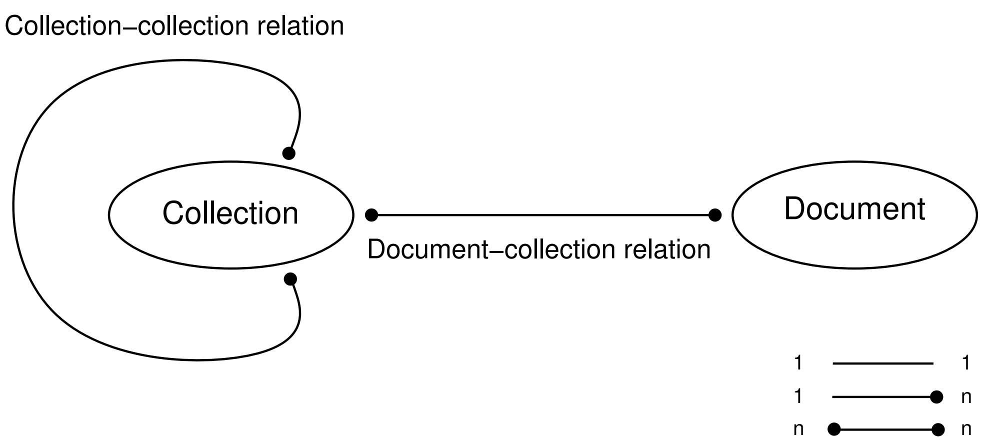

Figure 2.3: Collection-collection and document-collection relations.

Collection Heads

One object in collection may be designated:

- "CollectionHead": object is automatically opened when collection is opened; all collection members are listed in collection browser.
- "FullCollectionHead": collection head is assumed to contain links to all members of the collection. The collection members (may) remain unlisted.

Hyperlink and collection navigation become interchangable.

[Multiple collection heads → first one found]

Links in Hyper-G

- Links in text, image, audio, video, PostScript, and 3D model documents (→ *real* hypermedia).
- Links stored in *separate* database:
  - bidirectional (followable backwards)
  - graphical link map
  - automatic link maintenance
  - creating a link does not necessitate editing a document
- Link types: standard (reference), annotation, inline, texture, ...
- Link rights: private and group links.
- Links in HTML and VRML documents are extracted at upload time and merged in again on retrieval (and during document editing).
- Links are implemented internally as anchor-anchor relations.

Source and Destination Anchors

Doc. Type	*Position Attribute*
Text	$b_{start}\ \ b_{end}$
Image	Rect $x_0\ \ y_0\ \ x_1\ \ y_1$ Circle $x\ \ y\ \ r$ Ellipse $x_0\ \ y_0\ \ x_1\ \ y_1$ Polygon $x_0\ \ y_0,\ \ \ldots,\ \ x_n\ \ y_n$
Film	Rect *itp* $n: f_1\ \ x_0\ \ y_0\ \ x_1\ \ y_1,\ \ \ldots,\ \ f_n\ \ x_0\ \ y_0\ \ x_1\ \ y_1$ Circle *itp* $n: f_1\ \ x\ \ y\ \ r,\ \ \ldots,\ \ f_n\ \ x\ \ y\ \ r$ Ellipse *itp* $n: f_1\ \ x_0\ \ y_0\ \ x_1\ \ y_1,\ \ \ldots,\ \ f_n\ \ x_0\ \ y_0\ \ x_1\ \ y_1$
Audio	$s_{start}\ \ s_{end}$
3D Scene	*object* (Src) *object/group* (Src) $(p_x, p_y, p_z)\ \ (l_x, l_y, l_z)$ (Dst)
PostScript	$p: x,\ y,\ w,\ h$

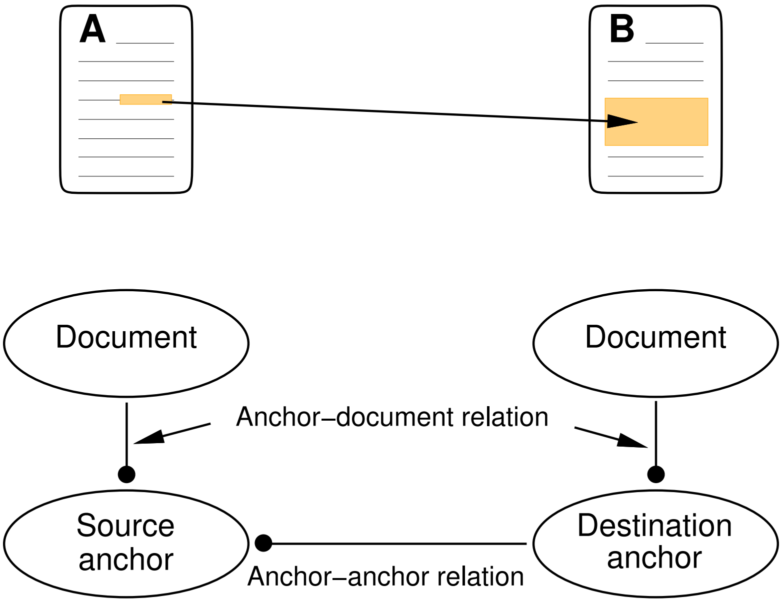

Figure 2.4: Link to destination anchor. Relation points to destination anchor.

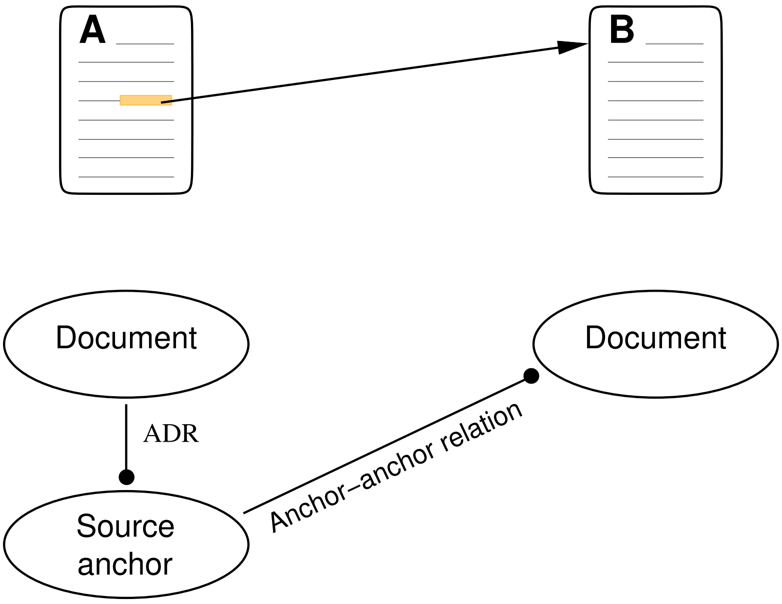

Figure 2.5: Link to entire document. Relation points to destination document.

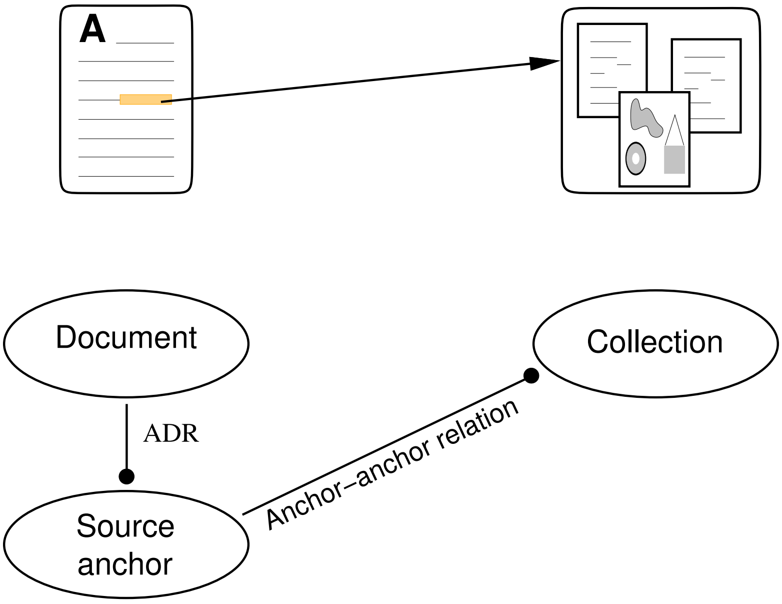

Figure 2.6: Link to collection. Relation points to destination collection.

Searching in Hyper-G

- Fully integrated attribute and full text search facilities.
- Standard attributes (Keyword, Title, Author, etc.) are always indexed.
- The content of text documents is represented in a full text inverted index.
- Indices are updated *automatically* when documents are inserted, edited, or deleted.
- Prefix, inexact, and boolean queries are supported.
- User-defined *scope* for searches: set of active collections, also *across* server boundaries.
- *Simultaneous* search across *multiple* servers.

User Groups and Access Permissions

- User accounts and passwords.
- User groups and subgroups.
- Access permissions on per collection or per document basis via Rights attribute: Read, Write, Unlink (delete).
- Blurred distinction: users → authors.

Access Permissions

Rights Attribute	*Access Permission*
empty	Everyone can R, only author can W and U
`R:a`	Only author can R, W, U
`R:g iicm`	Group `iicm` can R, only author can W and U
`R:u kandrews, g g1; W:g g1`	User `kandrews` and group `g1` can R, only group `g1` can W, only author can U
`W:u kandrews, g g1; U:g g1`	Everyone can R, only user `kandrews` and group `g1` can W, only group `g1` can U

User Identification Modes

1. *Identified* – name + password; full identity of user known to system (real name + any aliases).
2. *Anonymous* – no password; user configuration determined by terminal profile. Read-only access.

Identification Mode	*System Log*	*Charge*	*User Log*	*Write Access*
Identified	yes	yes	yes	yes
Anonymous	yes	yes[a]	no	no

[a]Special hardware required.

Home Collections

- Users have personal "home collections":
  - organise personal view of information space (kept on server → more flexible than client-side hotlists).
  - store personal documents (home page), prepare preliminary versions of documents and collections, etc.
- Default point of entry for identified users.
- Anonymous users enter "Default Home Collection".

Multilinguality

- Multilingual documents (text, audio, film, ...) stored in clusters.
- System chooses most appropriate language version according to user's language preference list.
- User interface also multilingual (Harmony).

3D Models and Visualisations

- 3D model fully integrated document type (VRML, SDF).
- Harmony VRweb 3D scene viewer displays models, supports navigation and interactive link definition.
- Harmony Information Landscape: 3D overview map of collection structure and link relationships.
- In future: 3D hyperlink and search result visualisations.

Annotations

- Special link type ANNOTATION.
- Can add comments to documents and collections.
- Annotations can be any kind of document (not just text).
- Set link rights for private or group annotations.

Messages and Conferencing

- Messages [Client →] Server → Client
- Broadcast to all connected clients: "Server going down for maintenance in 5 minutes!"
- Conferencing between users (talk).

Hyper-G Client/Server Protocol (HG-CSP)

- Client opens TCP connection on port 418 (by default).
- Protocol format negotiation: binary and ascii forms of protocol, binary preferred if both can handle it.
- Compression and protocol version negotiation.
- Messages are exchanged (semantics similar to RPC): control information via port 418, documents through separate channels.
- Documents (e.g. PostScript and VRML files) may also be transmitted in compressed form, depending on the capabilities of the client.
- Client closes connection (server after timeout).

Some HG-CSP Commands

GETCHILDREN	Get member IDs of given collection
GETOBJECTBYQUERY	Get object IDs matching given query
GETANCHORS	Get anchor IDs attached to given doc
GETOBJECT	Get object record with given ID
GETANDLOCK	Get object record and lock
CHANGEOBJECT	Modify object attributes
UNLOCK	Release lock on given object
PIPEDOCUMENT	Retrieve document on given port
INSERTOBJECT	Insert new document, collection, or link
DELETEOBJECT	Delete object with given ID
COMMAND	Stat, who, message, etc.

Document Formats

Document	*Format(s)*
Text	HTML, HTF
Inline Images	GIF, JPEG, TIFF, PNG
Images	GIF, JPEG, TIFF, PNG
Sound	WAV, AIFF, .au (Sun)
Video	MPEG-1
3D Scenes	VRML, SDF
PostScript	PostScript

Any other document type/format supported as generic document with external viewer (no hyperlinks).

Hyper-G Text Format (HTF)

Hyper-G's original native SGML text format:

- tags for markup
- entity references for ISO Latin-1 characters
- edit with any ASCII editor
- well-defined DTD – check conformance!

Now migrating to HTML.

Remote Objects

- Remote Objects "point" to resources on remote FTP, Gopher, WWW, and WAIS servers, as well as Telnet sessions.
- Protocol, Host, Port, Path attributes specify resource.
- Can be assigned title and keywords (for searching).

Generic Documents

- Special document types (CGM vector graphics, Excel spreadsheets, MIDI files, etc.) are inserted as Generic Documents.
- SubType attribute defines type of document.
- Passed to client as MIME-Type `application/x-SubType`
- MimeType attribute can also be assigned (passed on unchanged).

Caching and Replication

Hyper-G servers are proxy servers: clients should connect to their "local" (electronically) Hyper-G server.

- The server (temporarily) caches remote objects automatically for all local users.
- Important and heavily-used resources (entire collections) can be replicated (under manual control) to multiple servers. The Repl attribute stores the GOID of the original object.

Maintaining Referential Integrity

Small update messages sent between servers maintain consistency of cross-server links and collections.

- "Weak consistency" – converges to consistent state.
- P-Flood algorithm (Server/Server Protocol):
  - transmits updates to n servers in $O(log\ n)$ time
  - robust to server/network faults

Accounting, Billing, and Licensing

Two business models are currently supported:

- *Pricing*: Attach virtual price tag to individual documents in Price attribute. Virtual money is deducted from user's Account attribute.
- *Site Licence*: Server admin purchases one licence for each virtual copy of a collection. N licences mean that N users may read the collection at any one time.

Chapter 3

The Hyper-G Server

The Hyper-G Server

- The best Web server around!
- Supports HTML, CGI, and Java.
- Written in C++, with OO database (objects and relations).
- Binaries available for: SunOS, Solaris, HP-UX, ULTRIX, OSF1, IRIX, Linux, AIX (beta), FreeBSD (beta) [Windows NT soon]

  Free for educational institutions.
- 64MB RAM recommended (32MB for Sun and Linux), server software requires about 50MB disk.
- Source code available to members of HGC after signing non-disclosure agreement.

Hyper-G Server Architecture

- *Protocol Layer*: configurable gateways to HTTP, Gopher, etc.
- *Session Layer*: one lightweight process (hgserver) is forked per client connection (session). hgserver splits operations into small, fast transactions for the database layer.
- *Database Layer*: small, fast transactions are processed serially. Objects can be explicitly locked for longer transactions.

Preparing for Hyper-G Server Installation

The following instructions are also in the file `HOWTO` in the Hyper-G distribution.

- Create a new Unix user `hgsystem` with sufficient space in the home directory `~hgsystem`.
- Configure `/bin/csh` or `/bin/tcsh` as the shell and `.cshrc` as the startup file.
- Create a directory `/usr/local/Hyper-G` with owner `hgsystem` and mode `755` for various symbolic links. [or set the environment variable `HYPERG_HOME` to a different directory]
- If `perl` is not installed, install it. The perl interpreter should either be `/usr/local/bin/perl` or be in `hgsystem`'s `path` variable.

  Perl is available from `ftp://prep.ai.mit.edu/pub/gnu/perl5.000.tar.gz`

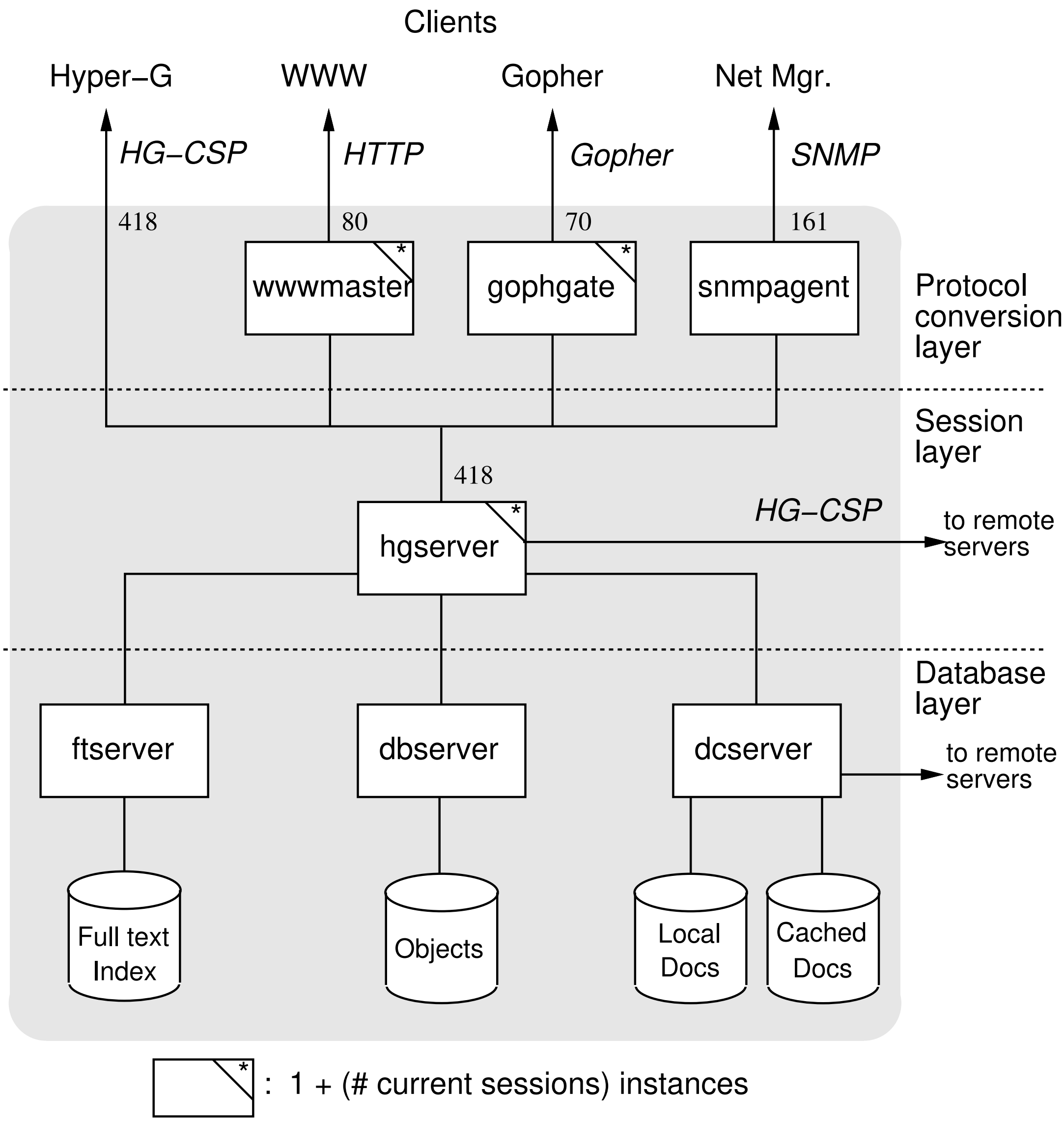

Figure 3.1: The modular architecture of the Hyper-G server.

Installing the Server Software

By ftp or from CD-ROM in Hyper-G book copy either the appropriate tar file, or the self-installation script `hginstserver` into `~hgsystem` as user `hgsystem`.

- From tar file:

  ```
  gzip -cd tar-file-name | tar xvpf -
  hginsttar
  ```

- Automatic update: with script `hginstserver` (it is not necessary to stop server while updating!).

A file `.hgrc` is created in `~hgsystem` and included at end of `.cshrc`

Completing Installation

- Log in as user `root` and compile the port binder:

  ```
  su
  cd ~hgsystem/samples
  cc -o hgbindport hgbindport.c
  cp hgbindport ~hgsystem/bin/$CPU
  chown root hgbindport
  chmod 04755 hgbindport
  exit
  ```

- Port numbers, caching, logging and other parameters can be configured by editing the file `.db.contr.rc`.
- Now installation is complete. To start the server, log in as `hgsystem` and execute `dbstart`.
- To stop the server at any time use `dbstop`.
- Tip: next, install the Harmony authoring tool.

Managing Users and User Groups

Use the `haradmin` or `hgadmin` administration tools:

- Create, edit, delete users and user groups.
- Assign descriptions, account balances, etc.
- Specify a user home collection [the collection itself must be created with an authoring tool such as Harmony or Amadeus].

CGI Programs

- First create a Hyper-G CGI Object:

  ```
  hginsdoc
  -hghost <your server>
  -pname <your collection>
  -type C
  -title 'A CGI Test Program'
  -name cgi-test
  -relurl /cgi-bin/cgi-test.pl
  ```

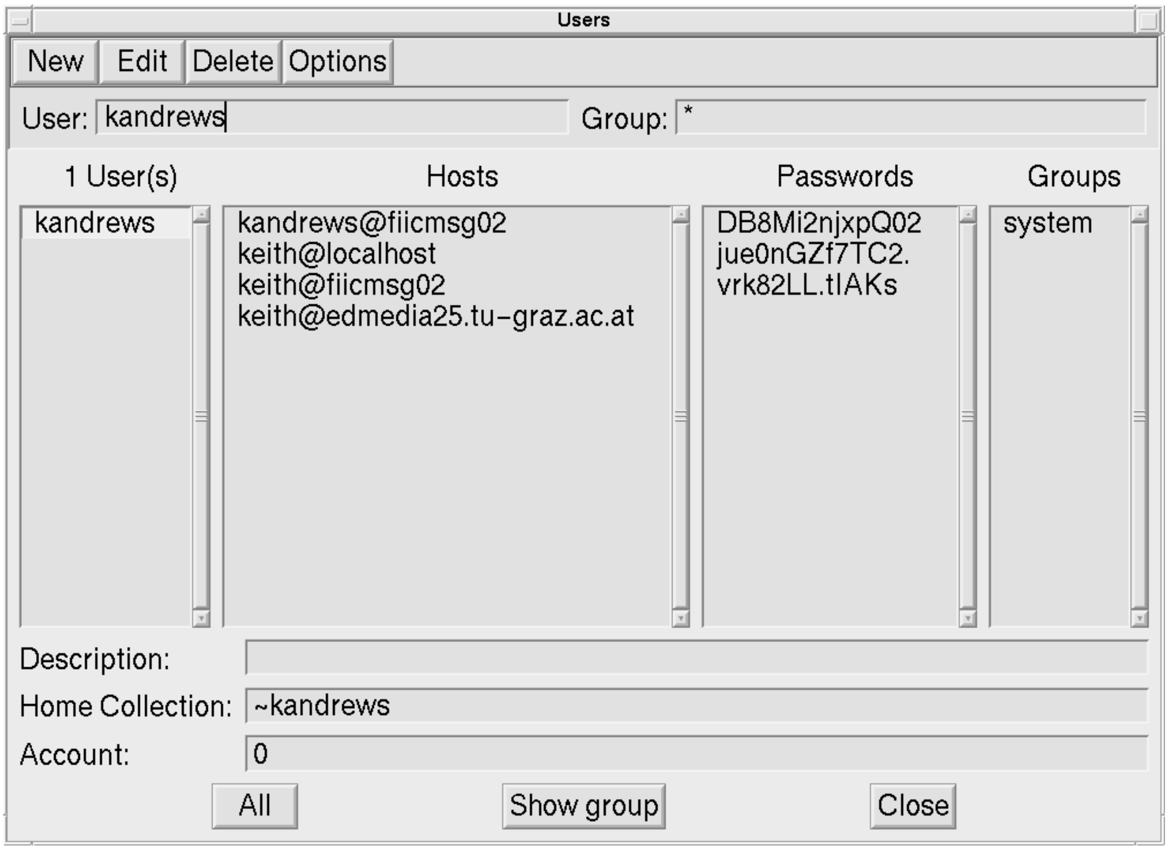

Figure 3.2: The HarAdmin administration tool. The Users window displaying selected users.

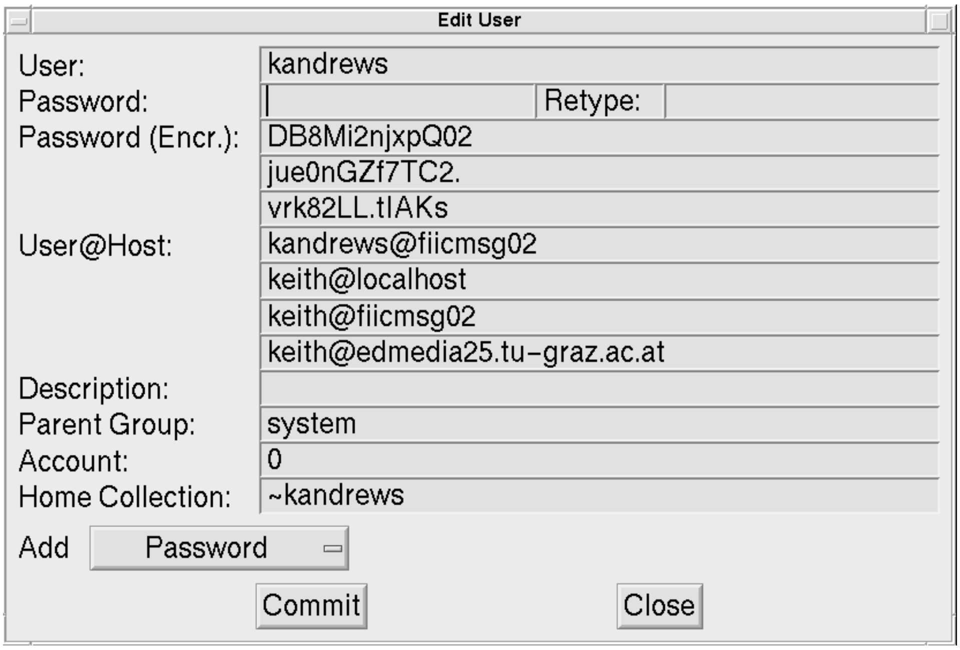

Figure 3.3: The HarAdmin administration tool. Editing the user `kandrews`.

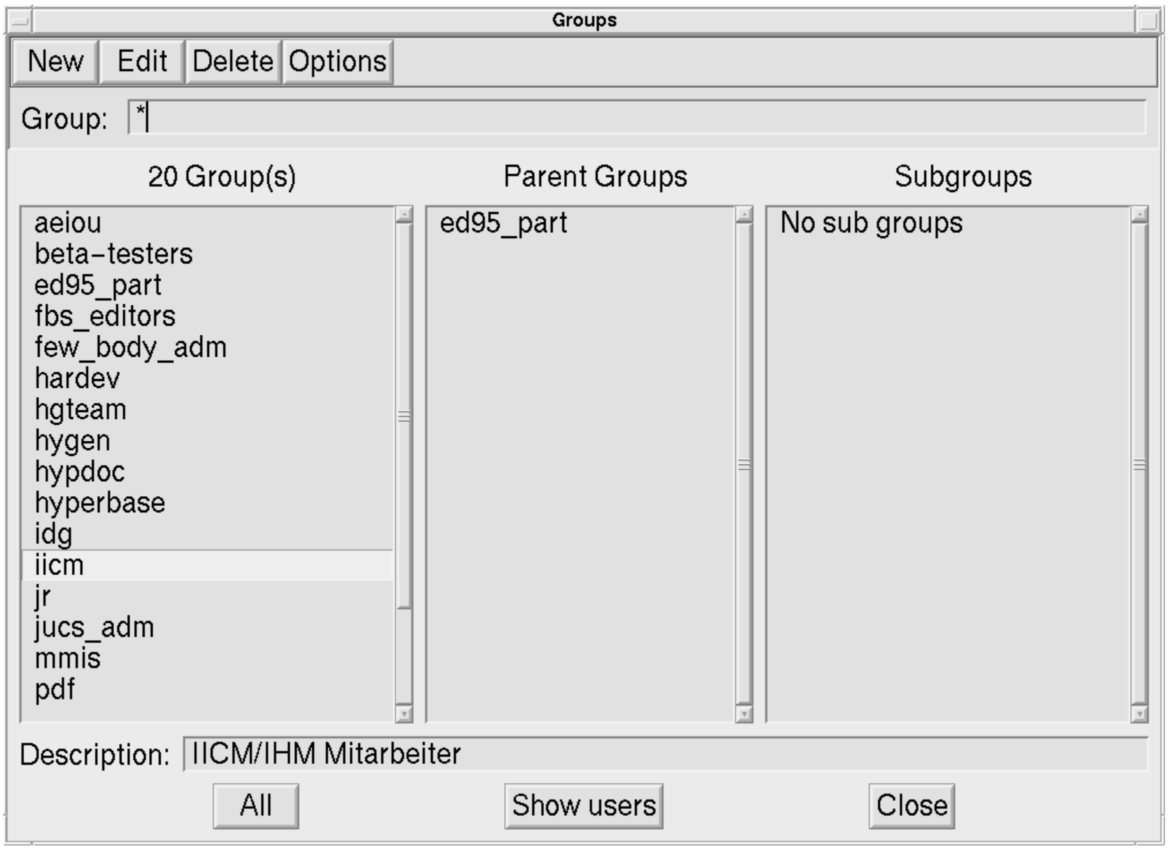

Figure 3.4: The HarAdmin administration tool. The Groups window displaying selected user groups.

- CGI program resides in `~hgsystem/dcserver/cgi/cgi-bin/` and is run by `dcserver`.
- Path attribute specifies physical location of CGI program, relative to `~hgsystem/dcserver/cgi`.
- Output is passed back to client.

HTML Forms

HTML form specifes the name of the Hyper-G CGI object in the ACTION attribute of the form.

```
<HTML>
<HEAD>
<TITLE>A Simple CGI Test Form</TITLE>
</HEAD>
<BODY>
<FORM METHOD="POST" ACTION="cgi-test">
<em>Insert some text here.
It will then be echoed by the script.</em>
<P>
<TEXTAREA NAME="text" ROWS=2 COLS=60></TEXTAREA><P>
<INPUT TYPE="submit" VALUE="Execute the script">
</FORM>
```

Java Applets

- Upload compiled Java class as Generic document of SubType java.

- Assign a name of the form: base/name
  e.g. `java/classes/Blink.class`
- In HTML document, specify base and name of class in the CODEBASE and CODE attributes of the APPLET construct.

```
<HTML>
<HEAD>
<TITLE>A Simple Java Applet</TITLE>
</HEAD>
<BODY>
<hr>
<applet CODEBASE="/java/classes" CODE="Blink.class" width=300 height=100>
<param name=lbl value="Hyper-G now features Java!
As you can see here, can you see the blinking text?">
<param name=speed value="4">
</applet>
<hr>
```

Server Log Files (wwwlog)

```
95/11/21 00:03:48 6490D817 xxx.microsoft.com
  *****SUCCESS_NEW_SESSION:Cvrweb
  [user_agent Mozilla/2.0b2 (Windows; I; 32bit)
  referer http://www.construct.net/tools/vrml/browsers.html]

95/11/21 00:03:52 6490D817 xxx.microsoft.com
  SUCCESS_LIST_COLLECTION:vrweb [0x811b9908 0x001711bd]

95/11/21 00:03:54 6490D817 xxx.microsoft.com
  SUCCESS_GET_IMAGE:search.gif

95/11/21 00:03:54 6490D817 xxx.microsoft.com
  SUCCESS_GET_IMAGE:options.gif

95/11/21 00:03:54 6490D817
  xxx.microsoft.com SUCCESS_GET_IMAGE:identify.gif

95/11/21 00:03:56 6490D817 xxx.microsoft.com
  SUCCESS_GET_IMAGE:help.gif

95/11/21 00:03:56 6490D817 xxx.microsoft.com
  SUCCESS_GET_MULTIMEDIA: VRweb Logo, big
  [0x811b9908 0x00179957 size 4060]

95/11/21 00:03:56 6490D817 xxx.microsoft.com
  SUCCESS_GET_IMAGE:home.gif

95/11/21 00:03:56 6490D817 xxx.microsoft.com
  SUCCESS_GET_MULTIMEDIA:VRML Logo
  [0x811b9908 0x0017dcb1 size 4222]

95/11/21 00:03:57 6490D817 xxx.microsoft.com
  SUCCESS_GET_IMAGE:coll_open.gif

95/11/21 00:03:59 6490D817 xxx.microsoft.com
  SUCCESS_GET_IMAGE:cluster.gif

95/11/21 00:04:19 6490D817 xxx.microsoft.com
  SUCCESS_GET_TEXT:VRweb license
  [0x811b9908 0x0017da98 size 3102]

95/11/21 00:04:21 6490D817 xxx.microsoft.com
  SUCCESS_GET_MULTIMEDIA: VRweb Logo, small
  [0x811b9908 0x0017995a size 1801]

95/11/21 00:04:36 6490D817 xxx.microsoft.com
  SUCCESS_GET_TEXT:VRweb FTP Sites
  [0x811b9908 0x0017dc4e size 1002]

95/11/21 00:04:49 6490D817 xxx.microsoft.com
  REDIRECT_TO_TARGET: VRweb mirror, NCSA, USA
```

Server Performance

No "hard data", but looking at IICM Hyper-G server (Jan 96):

- Running on Sun Sparcstation 10/512, 2 x 50 MHz proc., 128 MB RAM.
- Around 214,000 documents in 38,000 collections (incl. clusters), with 264,000 links, and 844 user accounts organised in 20 user groups.
- In Jan. 1996 server handled 154,000 user sessions (5,000 per day), resulting in 4.4 million dbserver transactions.
- At peak times, around 200 simultaneous user sessions.

Chapter 4

Hyper-G Clients (Authoring Tools)

Hyper-G Clients (Authoring Tools)

- Unix Terminal Viewer (hgtv).
- Harmony (Unix/X11).
- Amadeus (PC Windows).
- Mac (planned).
- Easy (Public Terminal Viewer).

HGTV (Unix Terminal Client for Hyper-G)

- Unix vt100 or xterm (C++, Curses library).
- Can also be run as telnet session, for example: `telnet info.tu-graz.ac.at` [User: `info`]
- Displays collection hierarchy and text documents (no inline images).
- External programs started for other document types (depending on capabilities of terminal).
- Edit collection structure, attributes, links, and texts.

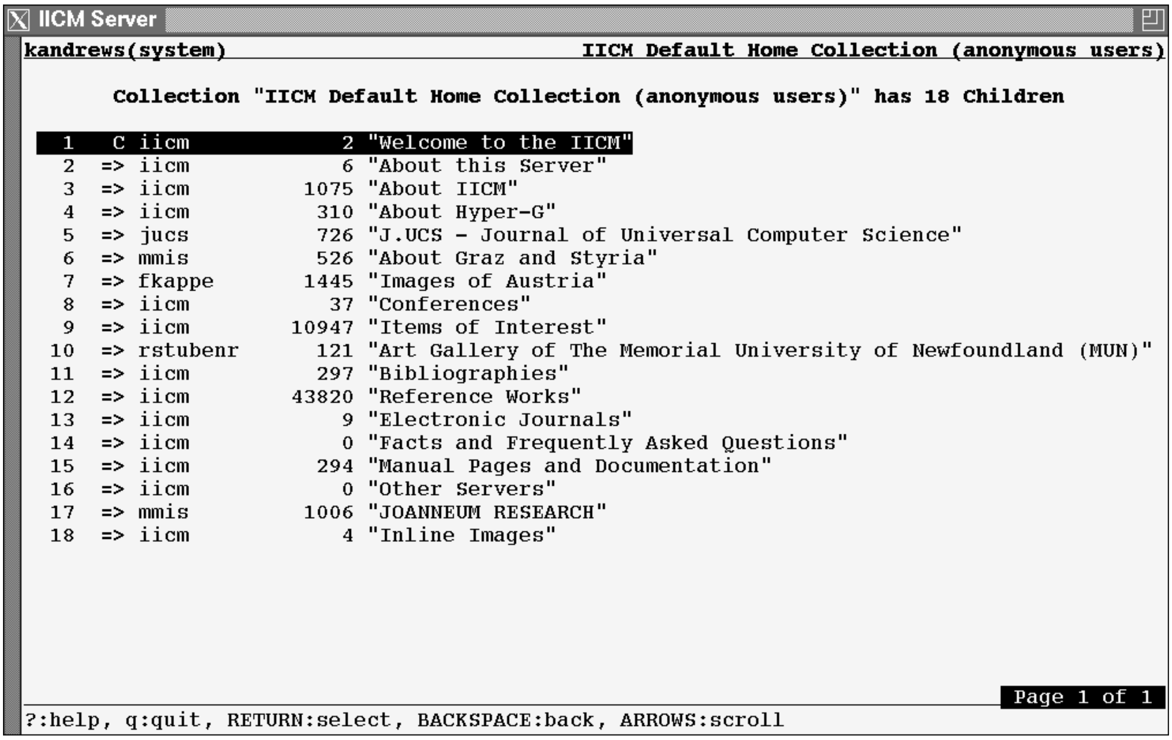

Figure 4.1: HGTV displaying a Hyper-G collection structure.

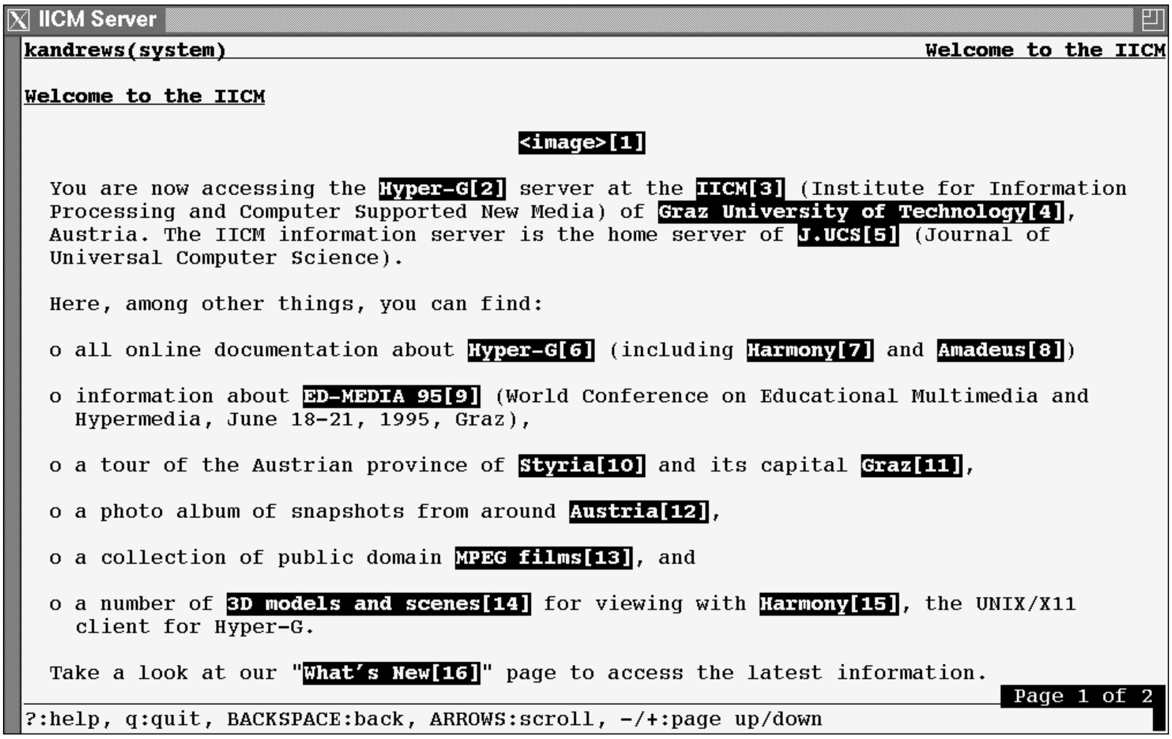

Figure 4.2: HGTV showing a text document.

Harmony (Unix/X11 Client)

- Written in C++, with InterViews UI toolkit, OpenGL/Mesa for 3D.
- Binaries freely available for: SunOS, Solaris, HP-UX, ULTRIX, OSF1, IRIX, Linux, FreeBSD (beta). [AIX soon]
- 32MB RAM recommended (16MB Linux), software requires about 30MB disk.
- Source code available after agreeing to licence terms.

Harmony Architecture

- Session Manager – main process, starts document viewers as necessary. [See Fig. 4.3]
- Native viewers for text, image, film, audio, PostScript, and 3D models (including hyperlinks).
- External programs started for other document types (configurable).
- Local map of incoming and outgoing hyperlinks (and other relationships).
- Location feedback → reduces disorientation. [Automatic display of location in collection structure of documents reached by search, hyperlinks, or local map]
- 3D information landscape.
- Insert (upload) documents, annotations.
- Edit attributes, links, and documents online.
- Multilingual interface.

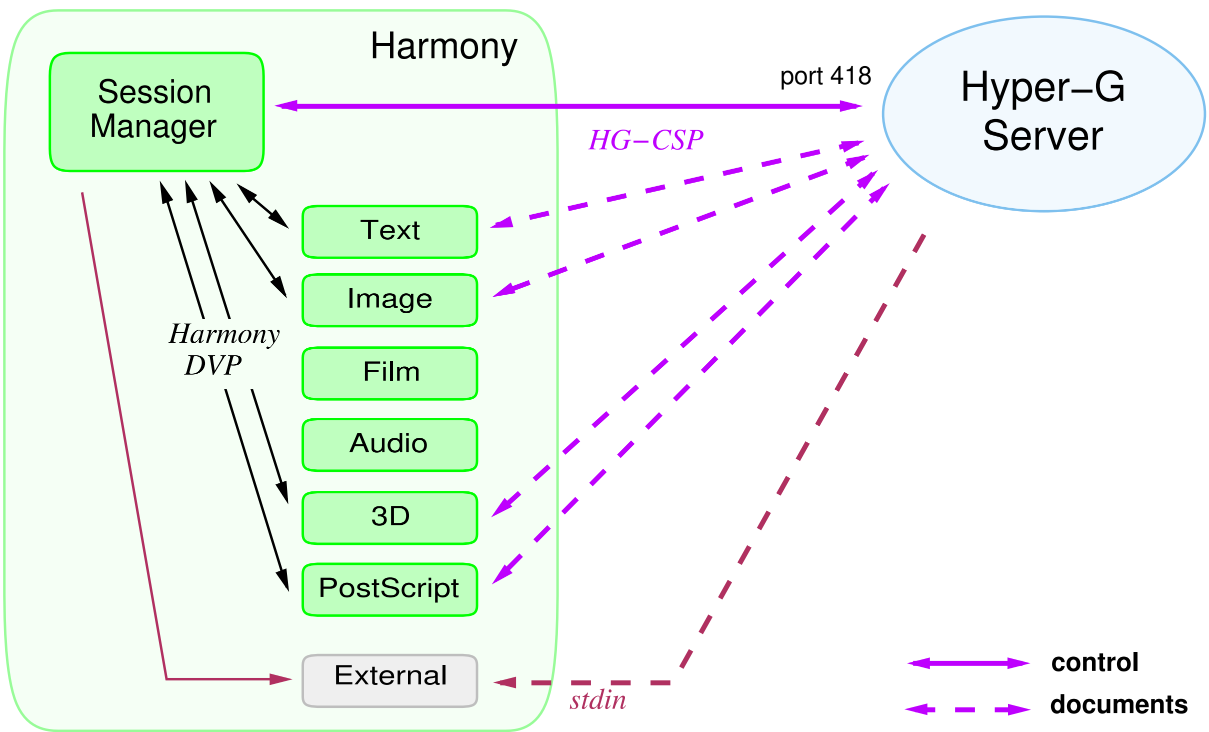

Figure 4.3: The Architecture of Harmony.

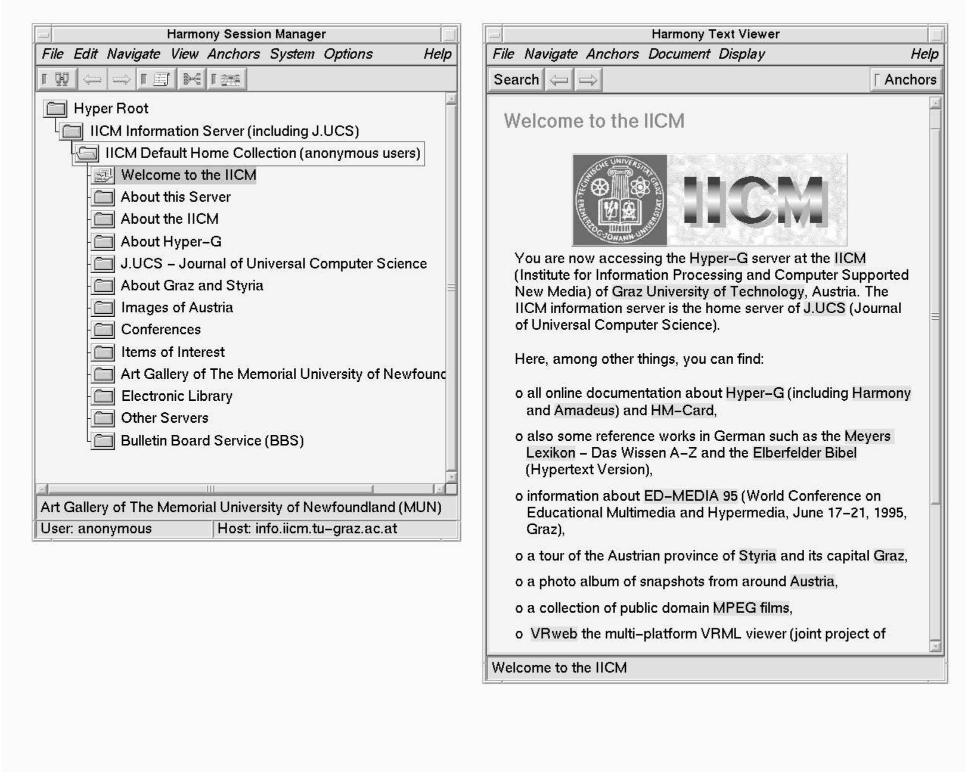

Figure 4.4: The Harmony Collection Browser and Text Viewer.

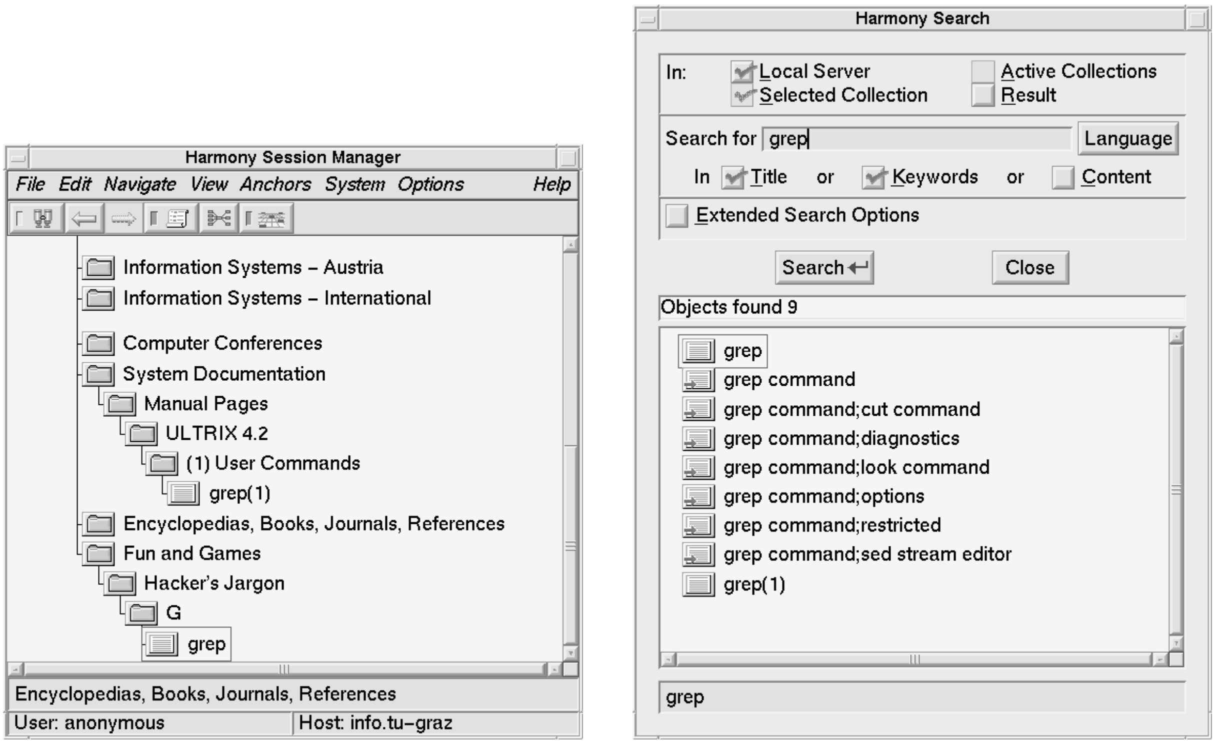

Figure 4.5: Harmony Location Feedback from Search Dialogue.

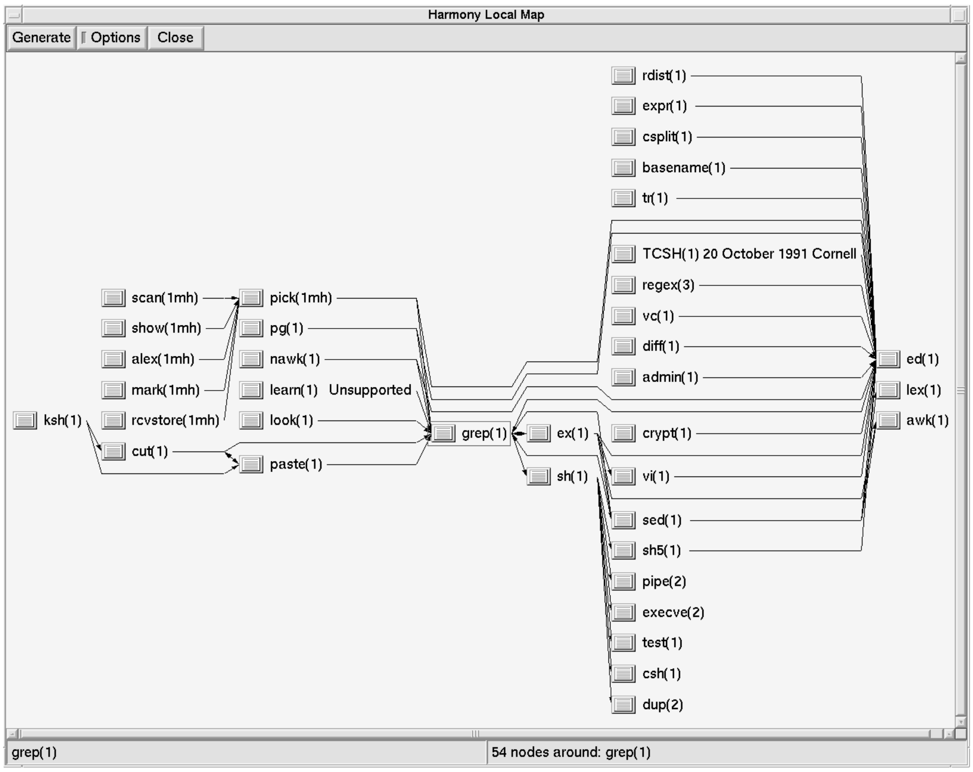

Figure 4.6: The Harmony Local Map. Two levels each of incoming and outgoing hyperlinks are shown around the grep(1) document.

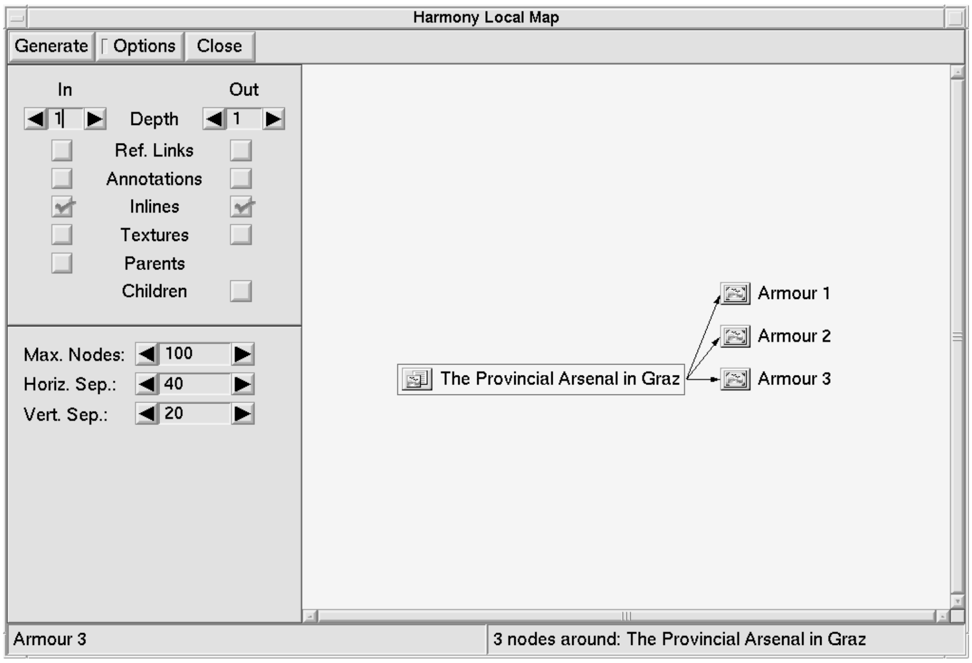

Figure 4.7: The Harmony Local Map displaying inline image relationships for a text document. The Options panel allows links to be filtered by type.

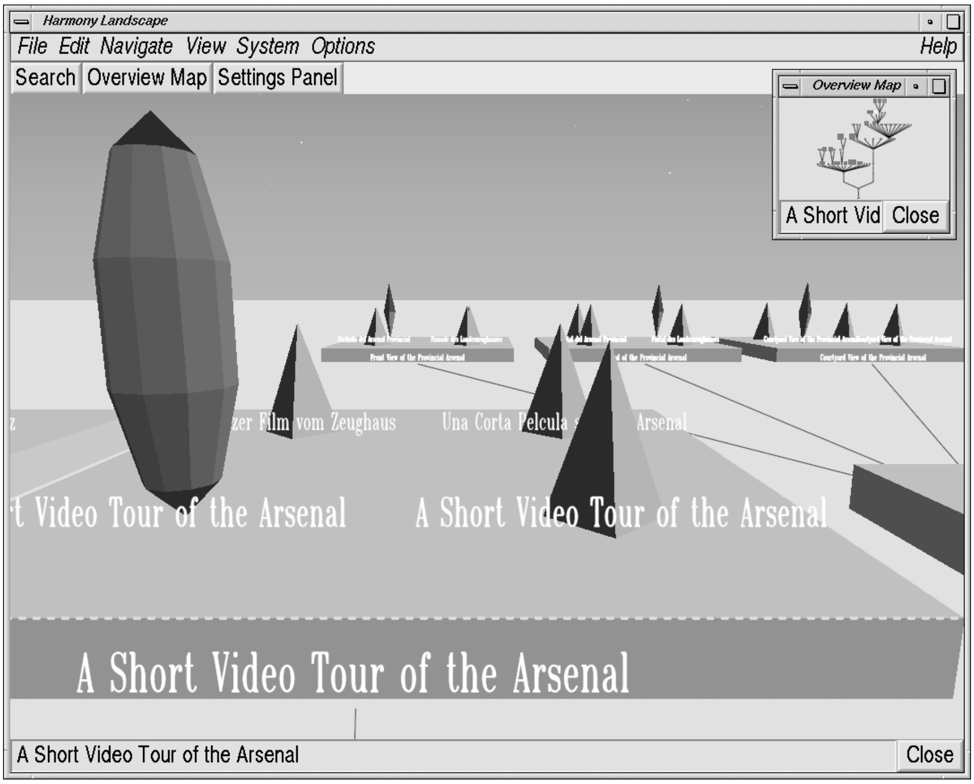

Figure 4.8: The Harmony Information Landscape.

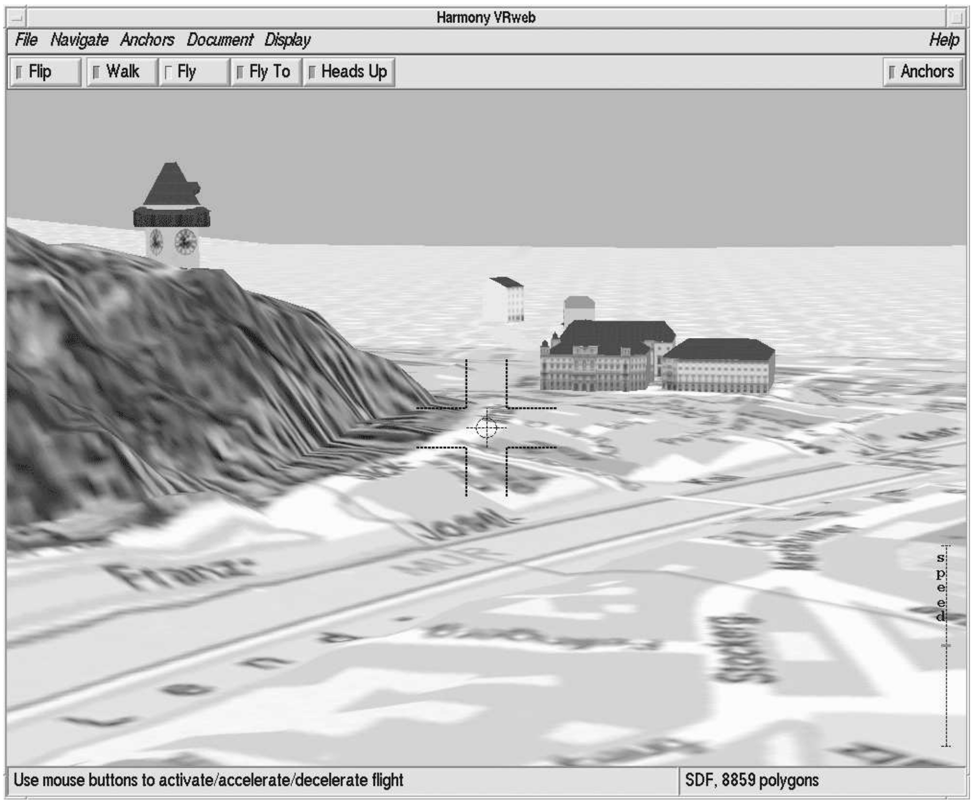

Figure 4.9: The Harmony VRweb 3D Viewer.

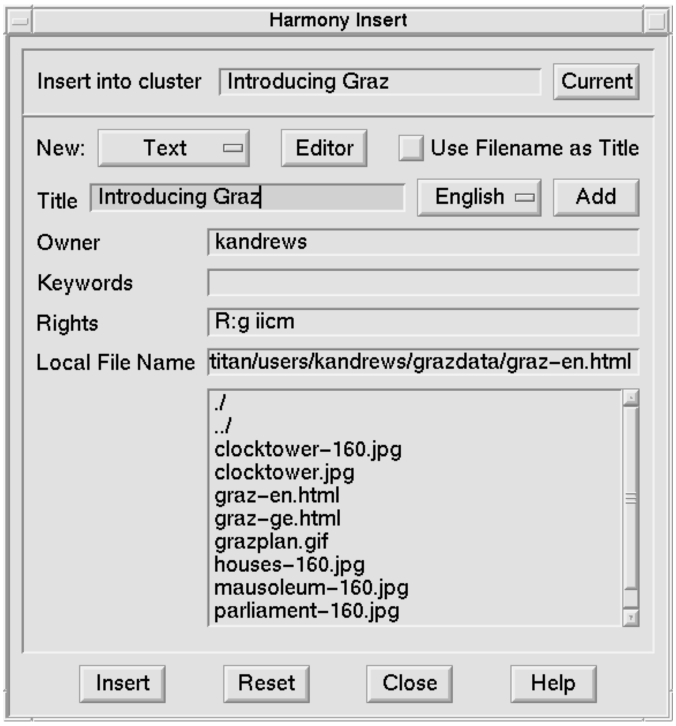

Figure 4.10: The Harmony Insert dialogue, uploading a text document.

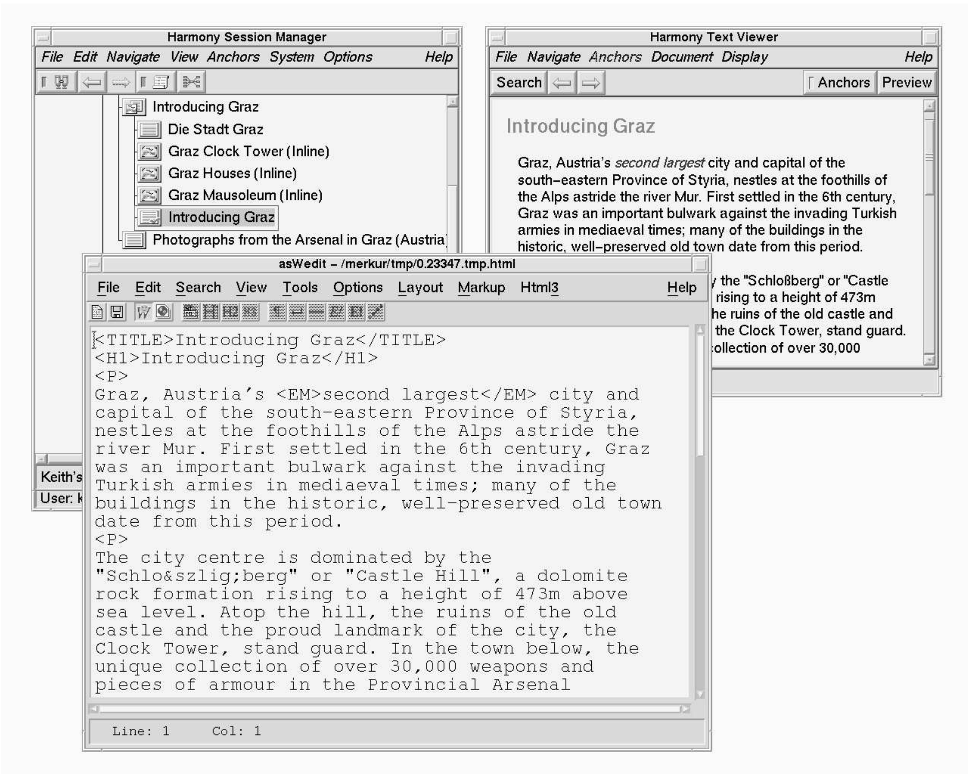

Figure 4.11: Harmony Editing a HTML Text with an External Editor.

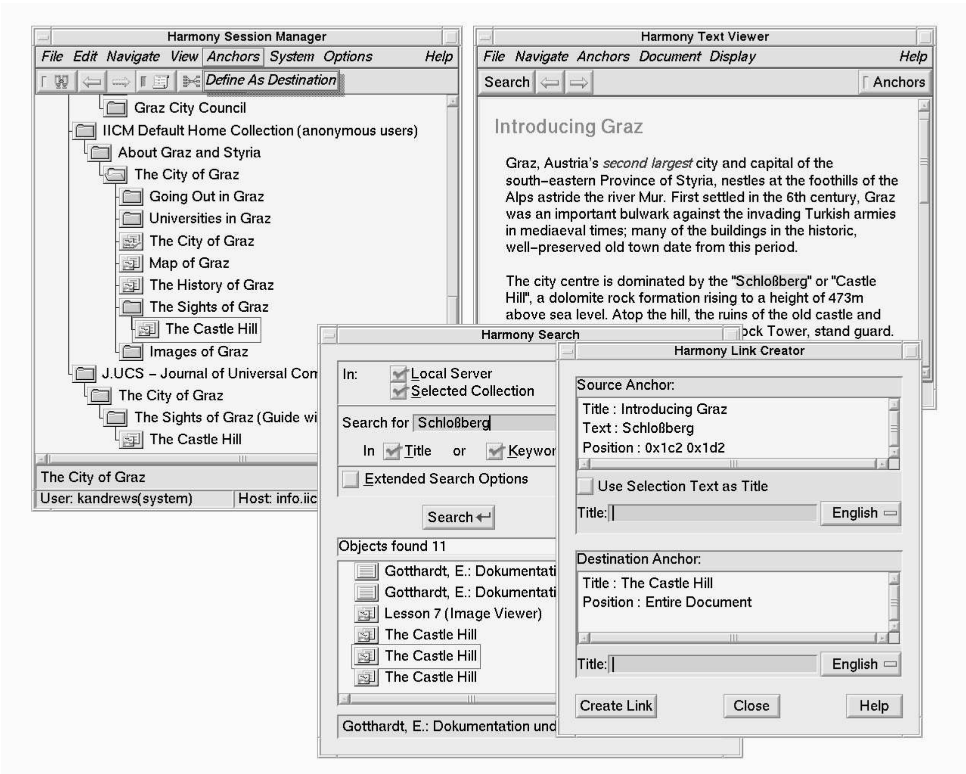

Figure 4.12: Interactive link editing with Harmony.

Amadeus (PC/Windows Client)

- PCs running Windows 3.1, NT, 95.
- Displays collection hierarchy one level at a time.
- Insert (upload) documents, annotations.
- Edit collection structure, attributes, links, and texts.
- Written in Visual C++.

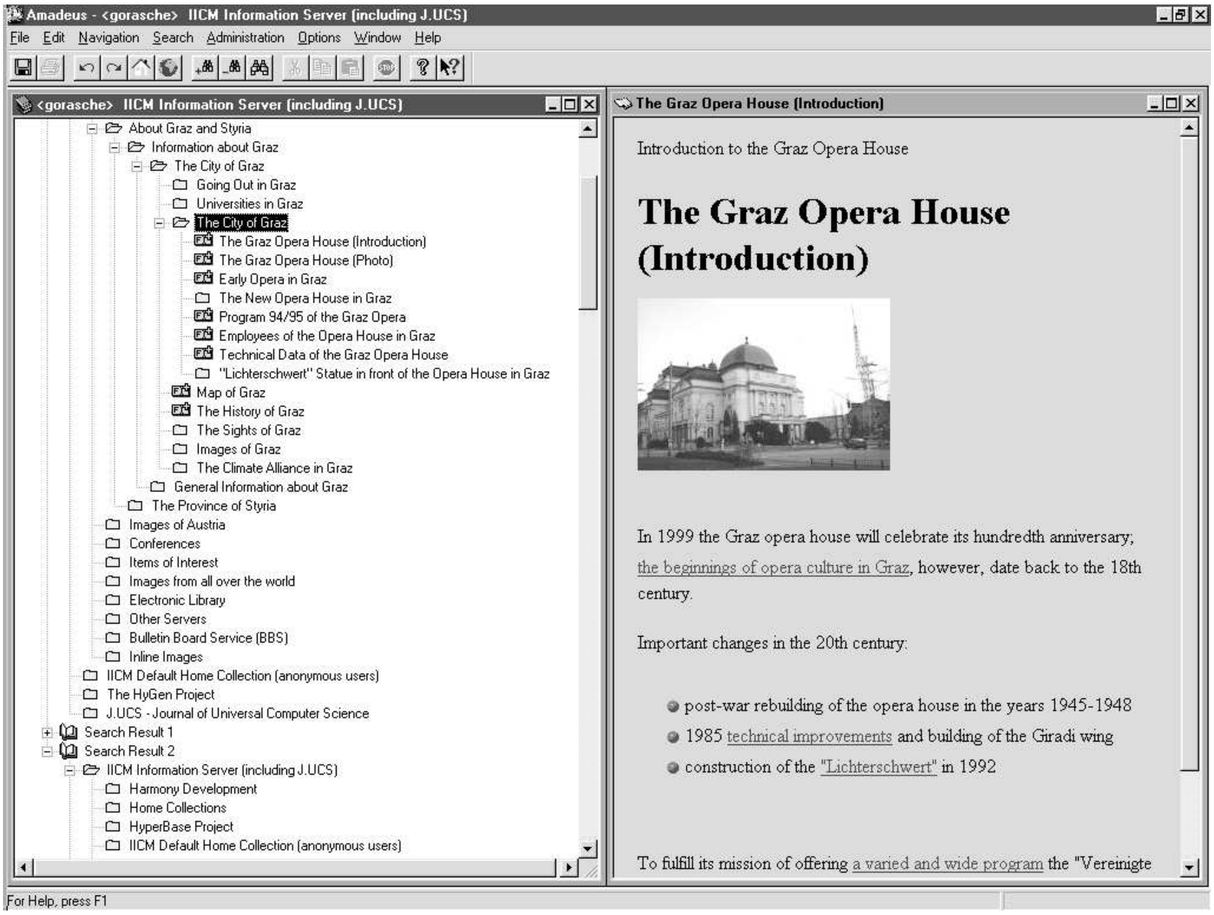

Figure 4.13: The Amadeus collection tree view and Text Viewer.

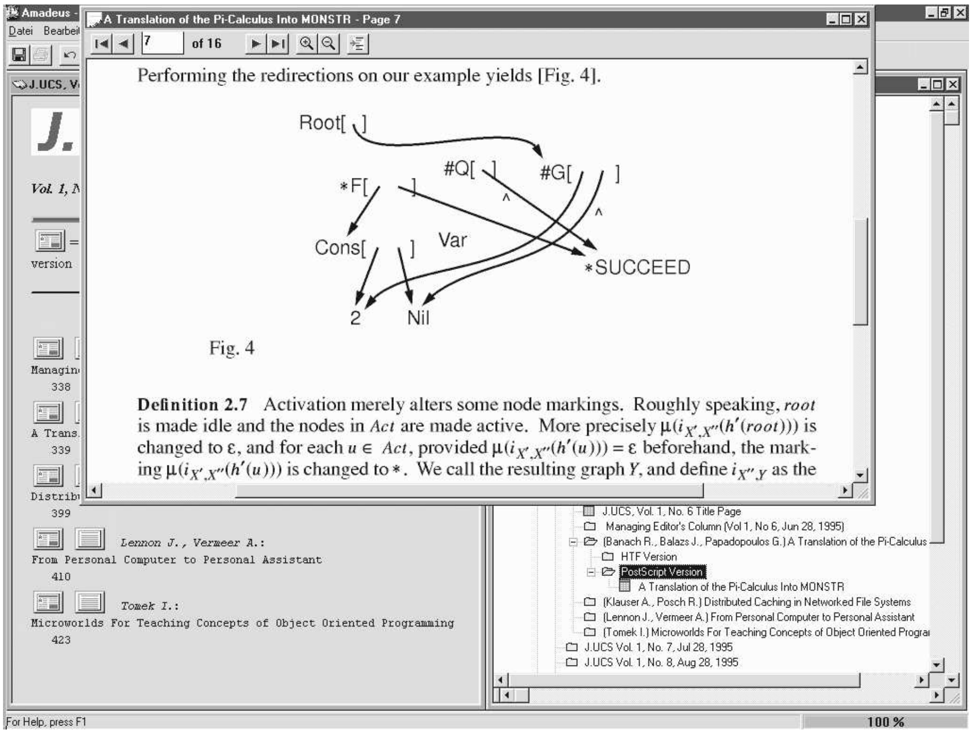

Figure 4.14: The Amadeus PostScript Viewer.

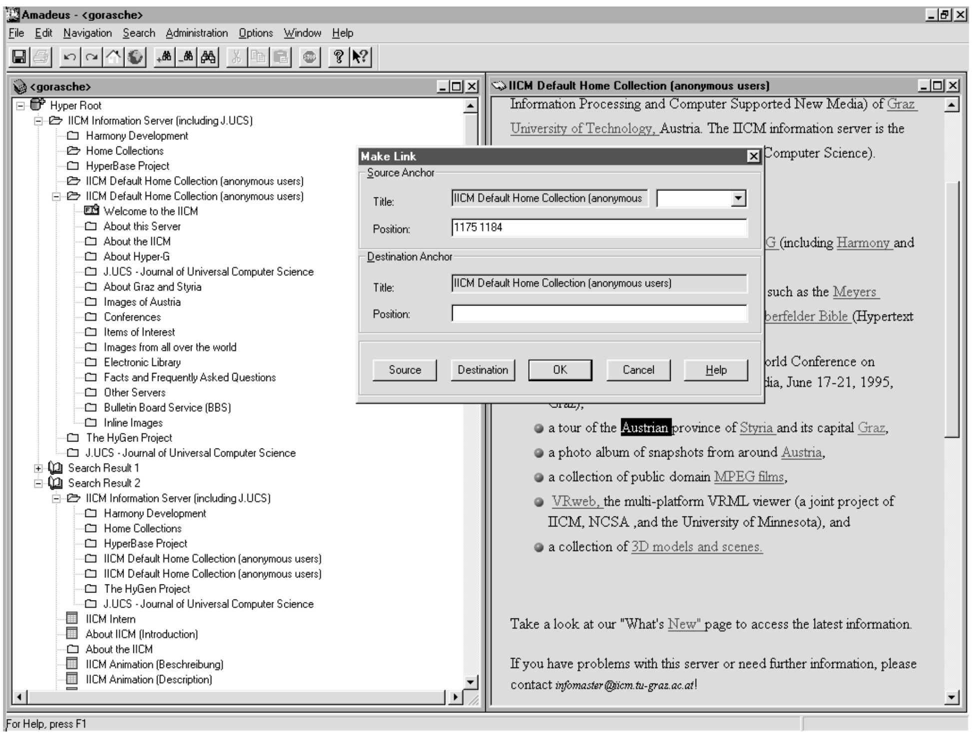

Figure 4.15: Interactive link creation in Amadeus.

Easy **(Public Terminal Viewer)**

- PCs running Windows 3.1, NT, 95.
- Interface designed for general public (museums, tourist info, etc.).
- Large buttons in toolbar (touch screen).
- Interprets layout and synchronisation attributes.
- SyncScript scripting language.

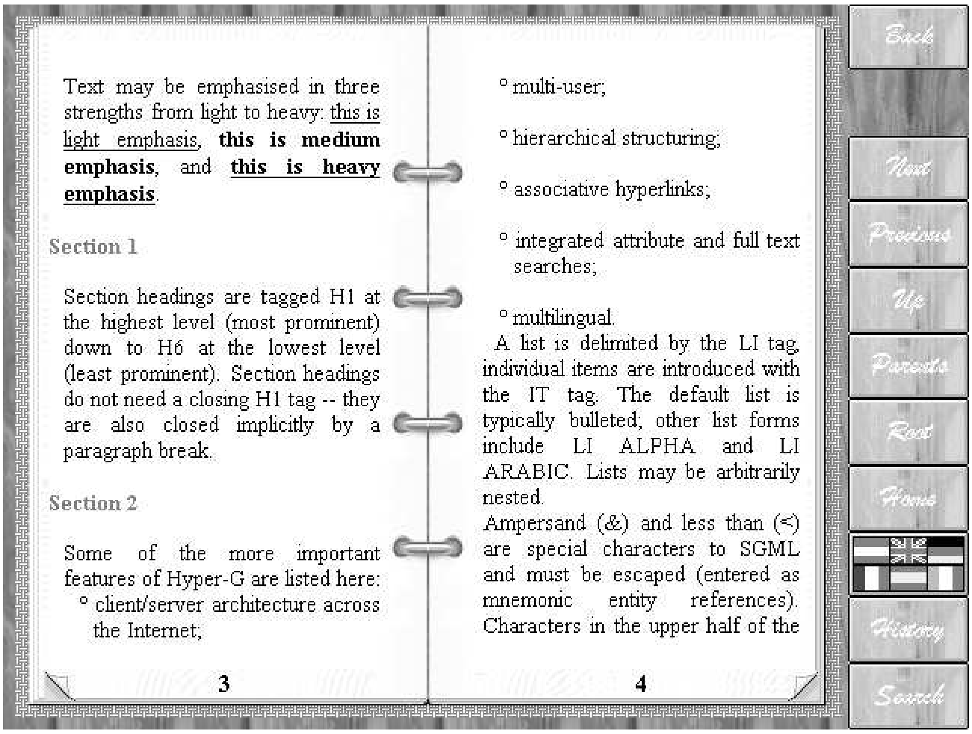

Figure 4.16: The Easy public terminal viewer. Here a text document is displayed using a book metaphor.

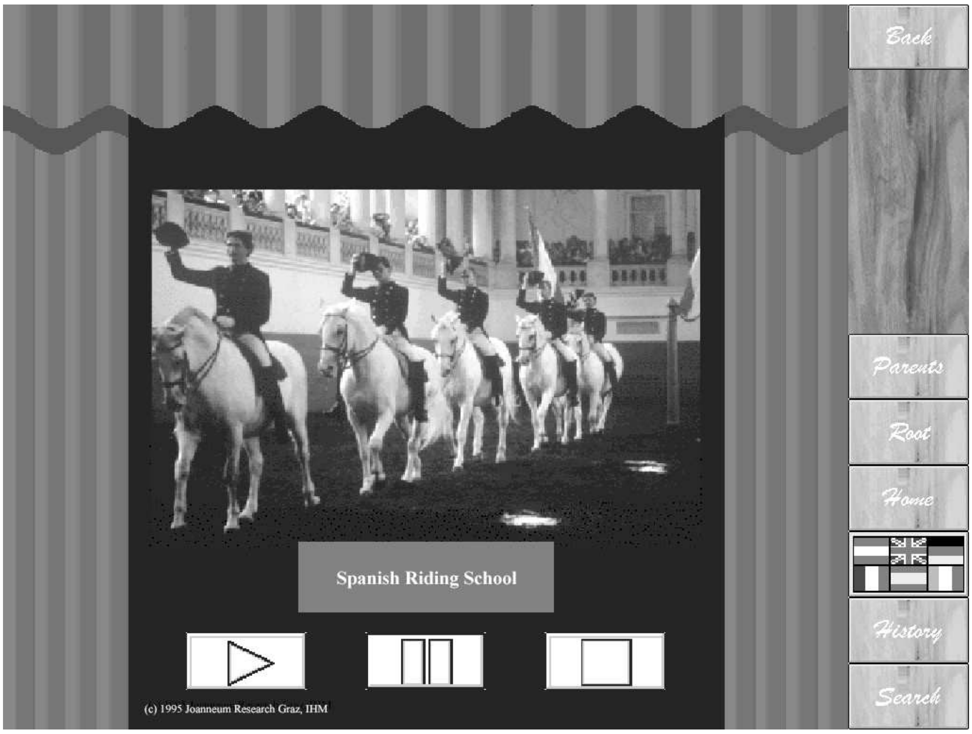

Figure 4.17: Easy displaying an MPEG film clip.

Figure 4.18: Easy synchronising text and audio.

Chapter 5

Hyper-G Tools and Utilities

Hyper-G Utilities

hgadmin	server admin (new users, groups, etc.)
hginfo	output information about objects
hgmodify	modify attributes of objects
hginscoll	insert new collection
hginsdoc/hginstext	insert new document
hggetdata	retreive document
hgdelobj	delete object
hgerase	recursively delete subtree
hifexport	export entire collection (HIF format)
hifimport	import entire collection (HIF format)
loadwww	load WWW directory tree into Hyper-G server
loadgopher	load Gopher directory tree into Hyper-G server
hgw3stat	statistics generator
hgbackup	backup entire server
hgrestore	restore entire server from backup

HIF (Hyper-G Interchange Format

- Encodes complete Hyper-G collections, including subcollections, documents, and links.
- Clear text format, documents are uuencoded.
- Used to archive and transport entire collections.

```
hifexport -hghost hyperg.iicm graz | gzip -c > graz.hif.gz
gzip -cd graz.hif.gz | hifimport -hghost localhost -auto "~anonymous"
```

A HIF File (Hyper-G Interchange Format)

The example below illustrates the overall structure of a HIF file.

```
HIF 1.0
  Author=kandrews(system)
  Server=pluto
  User=kandrews@merkur[129.27.153.3]
  TimeCreated=95/11/03 16:05:23 GMT
  Program=hifexport 1.15 [Frank Kappe]
  Commandline=hifexport -hghost pluto graz
#
#
BEGIN Collection
  ObjectID=0x00000004
  GOid=0x811b9908 0x00002aa3
  Type=Document
  Title=en:The City of Graz
  Title=ge:Die Stadt Graz
  Title=sp:La Ciudad de Graz
  Author=iicm
  TimeCreated=94/04/26 08:05:12
  TimeModified=95/10/19 10:39:42
  Sequence=10
  DocumentType=collection
  Name=graz
  Subdocs=656
END Collection

 BEGIN Collection
  BEGIN Cluster
  END Cluster

  ...

  BEGIN Collection
  END Collection
 END Collection


# END COLLECTION graz
```

Here we see a text document (uuencoded) and a source anchor object.

```
BEGIN Text
  ObjectID=0x0000001e
  GOid=0x811b9908 0x000d4cef
  Type=Document
  Title=en:Eating Out in Graz
  Author=iicm
  TimeCreated=95/01/19 18:37:15
  TimeModified=95/07/14 14:04:59
  Rights=W:g iicm
  DocumentType=text
  Path=DC0x000571d9 0x000006de
  Parent=0x0000001a
  BEGIN UUENCODE
    M/'1I=&QE/D5A=&EN9R!/=70@:6X@1W)A>@H\2#$^16%T:6YG($]U="!I;B!'
    M<F%Z"CQ0/@I'<F%Z(&AA<R!A(&AU9V4@;G5M8F5R(&]F(')E<W1A=7)A;G1S
    ...
    M9G)E9"!%:VQA=61E*2!F;W(@(DUU;'1I;65D:6$@26YF;W)M871I;VX@4WES
    M=&5M<R(N"CQ0/@H*"@H*"@H*"@H*"@H*"@H*"@H*"@H*"@H*"@H*"@H*"@H*
    #"@H*

  END UUENCODE
  BEGIN ANCHOR
    ObjectID=0x0000002b
    GOid=0x811b9908 0x000d97e3
    Type=Anchor
    Author=iicm
    TimeCreated=95/01/23 09:08:18
    TimeModified=95/07/14 14:04:58
    Rights=W:g iicm
    TAnchor=Src
    Position=0x0000062a 0x0000062e
    Dest=0x0000001c
    GDest=0x811b9908 0x000d4cf1
  END ANCHOR
END Text
```

LoadWWW

- Tool to "roll over" a WWW server tree into a Hyper-G collection tree.
- For example, `/dir/file.html` is mapped to a document named `dir/file.html`, which belongs to a collection named `dir`, which belongs to the collection `/` (which must be created in advance).
- Links are entered into the link database.
- Original URLs remain valid (assuming host remains same).

Standalone Hyper-G Server ("Local Database")

- Subset of server functionality.
- For offline reading and authoring.
- CD-ROMS, catalogs, proceedings, presentations.
- HIF file → local database [→ CD-ROM].
- Browse with Harmony, Amadeus, and Easy.

Chapter 6

Hyper-G as a Web Server

Hyper-G as a Web Server

- Structured hyperspace, collection structure and parents presented as list of links (optionally).
- Headers, footers, icons, etc. are all configurable (chunks of HTML).
- Guaranteed link consistency within Hyper-G.
- Hyper-G attributes available for every object.
- Focussed attribute and content search.
- Anonymous and identified users, access rights.
- CGI and SQL gateways.
- Multilinguality.

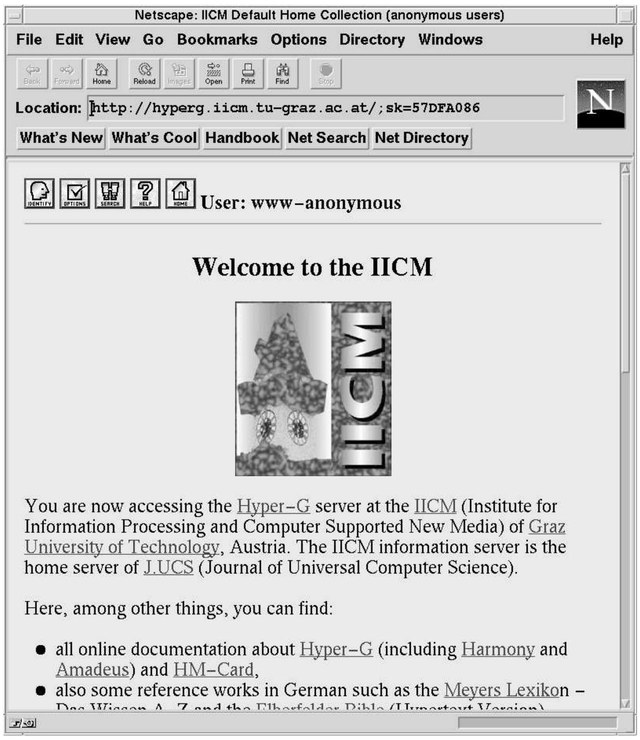

Figure 6.1: Accessing the IICM Hyper-G Server with Netscape. Hyper-G functionality is accessible via the buttons across the top of each page.

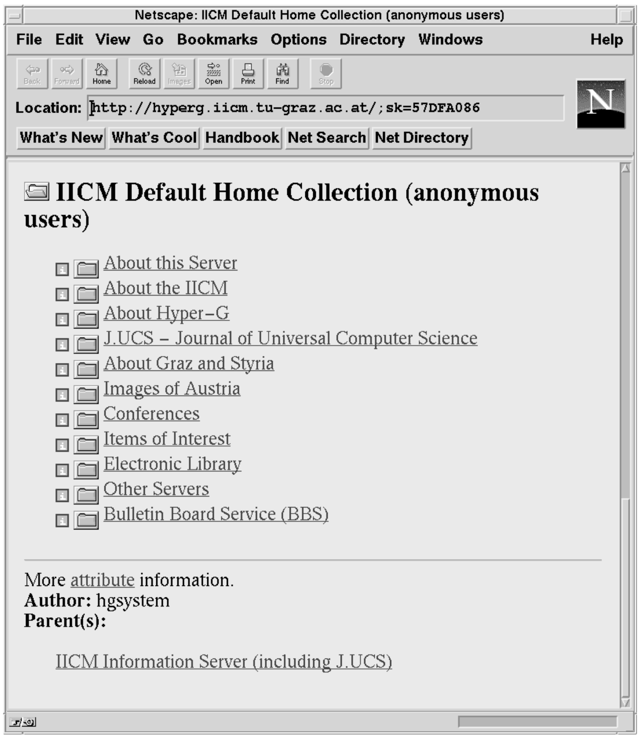

Figure 6.2: Accessing the IICM Hyper-G Server with Netscape. By default, all immediate members of the same collection are listed at the bottom of each page. Parent collections and attribute information is also available.

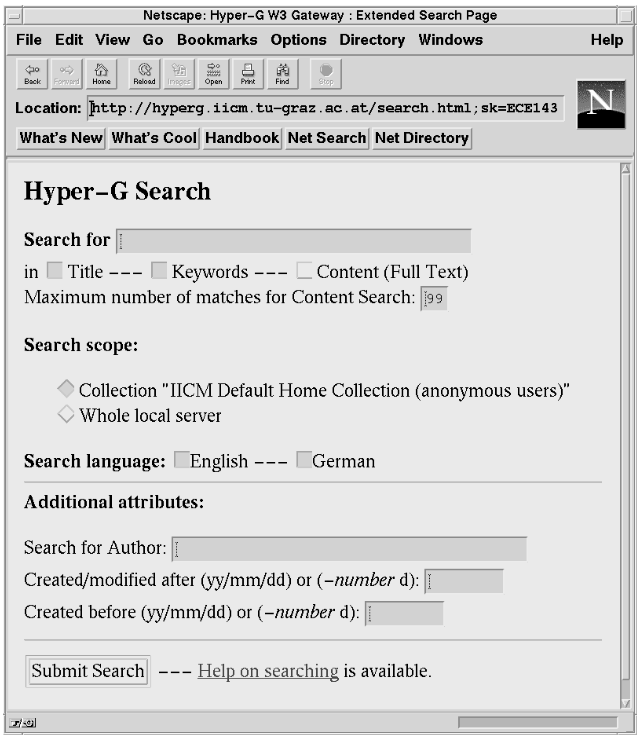

Figure 6.3: The Hyper-G Search Panel for Web Clients.

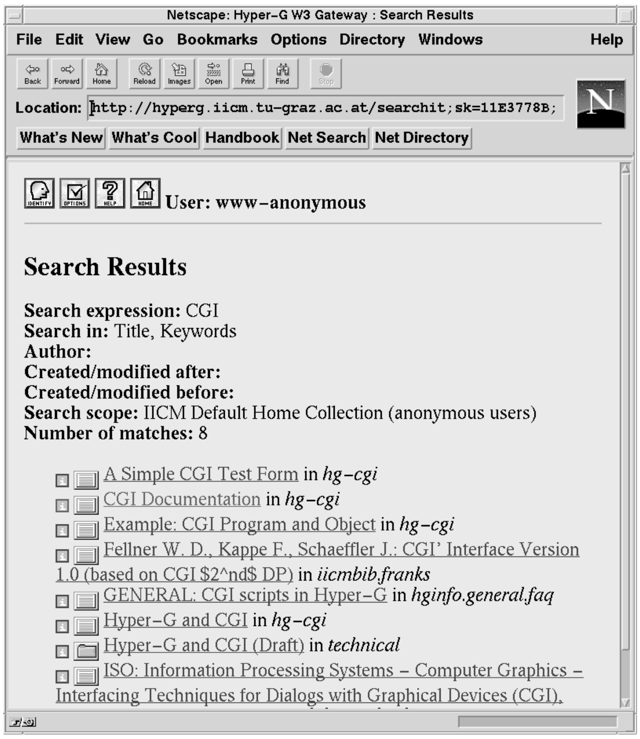

Figure 6.4: Search Results for the word "CGI".

Figure 6.5: The Status Panel for Web Clients.

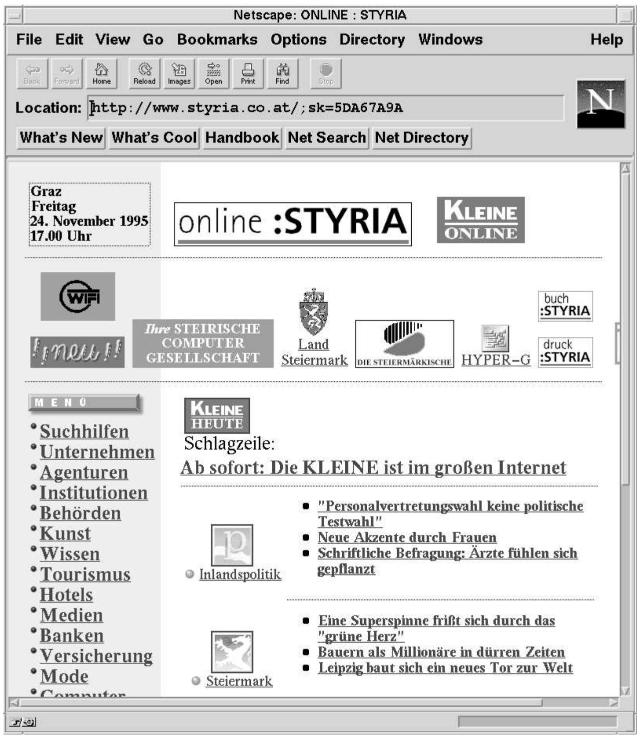

Figure 6.6: Styria Online: Hypermedia Publishing with Hyper-G (top of home page).

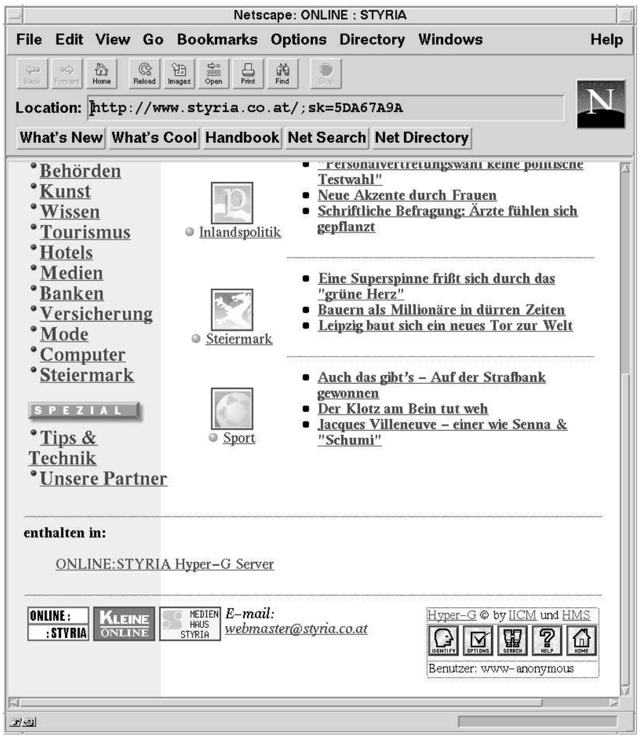

Figure 6.7: Styria Online: Hypermedia Publishing with Hyper-G (bottom of home page).

Figure 6.8: Kleine Online: Kleine Zeitung Daily Newspaper

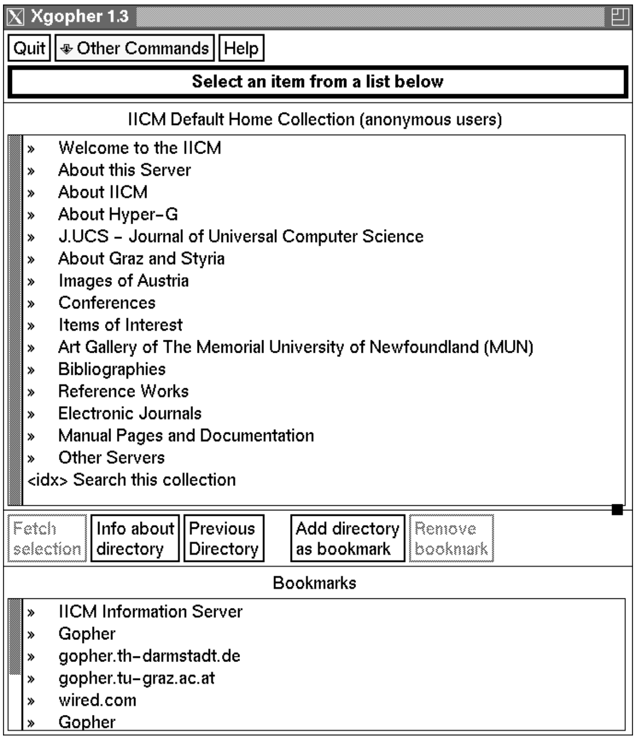

Figure 6.9: Accessing the IICM Hyper-G Server with Xgopher.

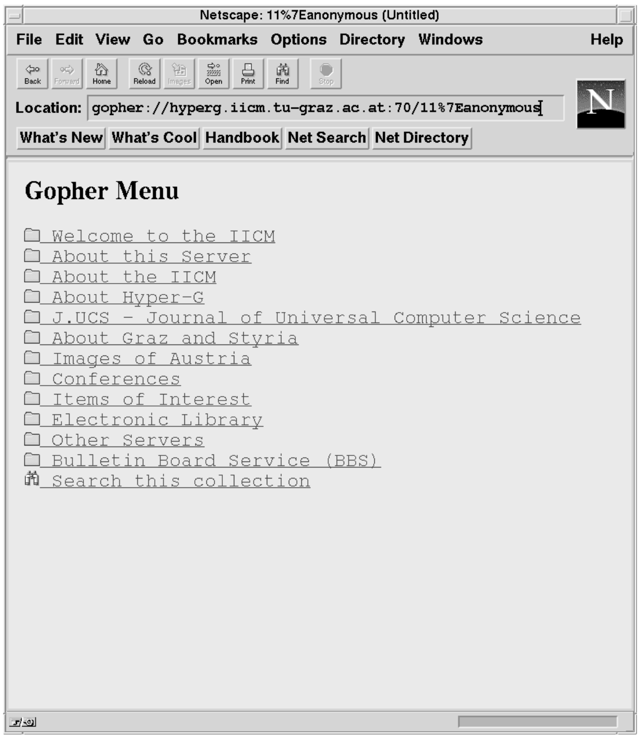

Figure 6.10: Accessing the IICM Hyper-G Server with Netscape through Gopher Protocol.

Chapter 7

Closing Remarks

Some Applications of Hyper-G

- University information system (e.g. TUGinfo). `http://info.tu-graz.ac.at`
- Information dissemination (e.g. European Space Agency GDS). `http://gds.esrin.esa.it`
- Internal company information system (e.g. HILTI, Lichtenstein).
- Network publishing: journals, newspapaers, encyclopedia, dictionaries, bibliographies (e.g. J.UCS, Kleine Online). `http://hyperg.iicm.tu-graz.ac.at/jucs` , `http://www.styria.co.at/`
- Hypertext discussion forum (e.g. Social Aspects of Telematics).

TUGinfo – University Information System

- Info about Graz University of Technology (TUG).
- Personnel (office, tel. no., email, etc.).
- Course descriptions, institute profiles, research reports.
- Abstracts of all Master's and PhD theses since 1990.
- Meyers Lexikon (44,000 documents), 3 copies. [reference to IICM Server]
- HCI (11,000) and SIGGRAPH (16,000) bibliographies.
- Telnet access to TUB library info system.
- MiniTASK Austrian company database (15,000 companies), only for TUG members.
- Austrian phone book, train timetables, weather, exchange rates (via Videotex).
- Gateways to other servers and information systems.
- Modem dial-up access:
  873-5200 14.4 bps.
  873-5201 28.8 bps.

J.UCS – Journal of Universal Computer Science

- Covers all areas of computer science.
- Distribution over Internet - access 24 hours a day.
- Six publicly accessible J.UCS servers worldwide.
- Gopher, WWW, and Hyper-G clients can be used.
- Submissions in PostScript (also RTF, LaTeX, and DVI).
- Papers distributed in PostScript and hypertext forms (both fully hyperlinked).
- Fully refereed (173 prominent referees).
- ACM Computing Reviews Categories.
- 12 issues per year online (1995 and 1996 free, 100$ per year thereafter).
- CD-ROM and printed versions (Springer) each year → fully citable.
- Papers are frozen, annotations are possible (refereed).

Strengths of Hyper-G

- *Real* hypermedia: text, image, audio, video, postscript, and 3D models, *including* hyperlinks.
- *Structured* hypermedia: composition (even across server boundaries), hierarchical navigation, focussed searches.
- Links stored in *separate* database: followable backwards, local map, link consistency.
- *Integrated* full text and attribute search.
- User identification modes and groups.
- Access permissions on per collection and per document basis (users → authors).
- Hyper-G is r/w: clients can *edit* database contents (not just browse), depending on access rights.
- Documents and collections can be named.
- Multilinguality in data and interface.
- 3D models and visualisations.
- Document caching and replication.

Hyper-G Newsgroup

- Newsgroup

    `comp.infosystems.hyperg`

- Mailing List (gatewayed to newsgroup)

    To subscribe, send mail to

    `listproc@iicm.tu-graz.ac.at`

    with

    `subscribe hyper-g <Your Name>`

    in the body of the message. To unsubscribe, send:

    `unsubscribe hyper-g <Your Name>`

- Archive

    An archive of the mailing list/newsgroup is maintained by Achim Bohnet

    `<ach@rosat.mpe-garching.mpg.de>`

    at:

    `http://www.rosat.mpe-garching.mpg.de/mail-lists/Hyper-G`

Feedback and Support

- Hyper-G FAQs

    `http://hyperg.iicm.tu-graz.ac.at/hyperg-faq`

- Hyper-G Support

    Please direct any feedback (comments, suggestions, bug reports, etc.) to:

    `hgsupport@iicm.tu-graz.ac.at`

Hyper-G Consortium (HGC)

- Founded 25th Sep. 1995, to coordinate further development of Hyper-G. `http://hgc.org/`
- Director Bruno Buchberger, RISC, Linz.
- 1996 membership $5000 ($500 non-profit orgs.).
- Currently 20 members and 11 sponsors (March 96).
- HGC members have access to Hyper-G source code.
- Two meetings per year.

Work in Progress

- Full HTML support in Harmony and Amadeus.
- Integration of Email, News, FTP, Z39.50.
- Server SQL gateway.
- Authentication and encryption (public key, zero knowledge protocols).
- Adobe PDF support.

When to use a Hyper-G Server

- When the information space is *large*.
- When the information space is *complex*.
- When the information space is *highly dynamic*.
- When *consistency* is an issue.
- In a *multi-author* environment.
- For *high-quality* network publishing.

Note: Information consumers may use Web, Gopher, or Hyper-G clients!

Hyper-G Mirror Sites

Australia	ftp://ftp.cinemedia.com.au/pub/Hyper-G
	ftp://gatekeeper.digital.com.au/pub/Hyper-G
Austria	ftp://ftp.iicm.tu-graz.ac.at/pub/Hyper-G
	ftp://ftp.tu-graz.ac.at/pub/Hyper-G
Czech Rep.	ftp://sunsite.mff.cuni.cz/Net/Infosystems/Hyper-G
	http://sunsite.mff.cuni.cz/ftp/Net/Infosystems/Hyper-G
Germany	ftp://elib.zib-berlin.de/pub/InfoSystems/Hyper-G
	ftp://ftp.ask.uni-karlsruhe.de/pub/infosystems/Hyper-G
Italy	ftp://ftp.esrin.esa.it/pub/Hyper-G
Poland	ftp://sunsite.icm.edu.pl/pub/Hyper-G/
	http://sunsite.icm.edu.pl/pub/Hyper-G/
Portugal	ftp://ftp.ua.pt/pub/infosystems/www/Hyper-G
	http://ftp.ua.pt/pub/infosystems/www/Hyper-G
Spain	ftp://ftp.etsimo.uniovi.es/pub/Hyper-G
Sweden	ftp://ftp.sunet.se/pub/Networked.Information.Retrieval/
UK	ftp://unix.hensa.ac.uk/mirrors/Hyper-G
USA	ftp://ftp.ncsa.uiuc.edu/Hyper-G
	ftp://mirror1.utdallas.edu/pub/Hyper-G