

Greenstone 3 : A modular digital library.

Katherine Don, George Buchanan and Ian H. Witten

Department of Computer Science
University of Waikato
Hamilton, New Zealand
{kjdon, grbuchan, ihw}@cs.waikato.ac.nz

Greenstone Digital Library Version 3 is a complete redesign and reimplementation of the Greenstone digital library software. The current version (Greenstone 2) enjoys considerable success and is being widely used. Greenstone 3 will capitalise on this success, and in addition it will

- improve flexibility, modularity, and extensibility
- lower the bar for “getting into” the Greenstone code with a view to understanding and extending it
- use XML where possible internally to improve the amount of self-documentation
- make full use of existing XML-related standards and software
- provide improved internationalisation, particularly in terms of sort order, information browsing, etc.
- include new features that facilitate additional “content management” operations
- operate on a scale ranging from personal desktop to corporate library
- easily permit the incorporation of text mining operations
- use Java, to encourage multilinguality, X-compatibility, and to permit easier inclusion of existing Java code (such as for text mining).

Parts of Greenstone will remain in other languages (e.g. MG, MGPP); JNI (Java Native Interface) will be used to communicate with these.

A description of the general design and architecture of Greenstone 3 is covered by the document *The design of Greenstone3: An agent based dynamic digital library* (design-2002.ps, in the gsdl3/docs/manual directory).

This documentation consists of several parts. Section 1 is for administrators, and covers Greenstone 3 installation, how to access the library, and some administration issues. Section 2 is for users of the software, and looks at using the sample collections, creating new collections, and how to make small customisations to the interface. The remaining sections are aimed towards the Greenstone developer. Section 3 describes the run-time system, including the structure of the software, and the message format, while Section 4 describes the collection building process. Section 5 describes how to add new features to Greenstone, such as how to add new

services, new page types, new plugins for different document formats. Section 6 describes how to make Greenstone run in a distributed fashion, using SOAP as an example communications protocol. Finally, there are several appendices, including how to install Greenstone from CVS, some notes on Tomcat and SOAP, and a comparison of Greenstone 2 and Greenstone 3 format statements.

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1 Greenstone installation and administration

This section covers where to get Greenstone 3 from, how to install it and how to run it. The standard method of running Greenstone 3 is as a Java servlet. We provide the Tomcat servlet container to run the servlet. Standard web servers may be able to be configured to provide servlet support, and thereby remove the need to use Tomcat. Please see your web server documentation for this. This documentation assumes that you are using Tomcat. To access Greenstone 3, Tomcat must be started up, and then it can be accessed via a web browser.

1.1 Get and install Greenstone

Greenstone 3 is available from <http://www.greenstone.org/greenstone3>. There are currently two releases: one of Linux, one for Windows. They were built using InstallShieldX, a new multi-platform installer software. This uses Java and is quite slow.

Greenstone 3 is also available through CVS (Concurrent Versioning System). This provides the latest development version, and is not guaranteed to be stable. Appendix A describes how to download and install Greenstone 3 from CVS.

1.1.1 Linux

Download the latest version of the installer, `gsdl3-x.xx-linux`, and run it in a shell (`./gsdl3-x.xx-linux`). The installation process will prompt you for the installation directory, the name of your computer and what port to run Tomcat on (the defaults being `localhost` and `8080`). Once Greenstone 3 has been installed, you can start the library by running `.gs3-launch.sh` from the `gsdl3` directory, and opening up a browser pointing to `http://localhost:8080/gsd13` (substituting your chosen name and port if necessary).

1.1.2 Windows

Download the latest Windows installer, `gsdl3-x.xx-win32.exe`, and double click it to start the installation. You will be prompted for the installation directory, installation type, your computer name and the port number to run Tomcat on (defaults are `localhost` and `8080`). Once Greenstone 3 is installed, you can access the library by selecting `Greenstone Digital Library 3` in the Start menu.

1.1.3 Accessing the library in a browser

Once you have started up the library (see the previous sections for OS dependent instructions), you can access it in a browser at `http://localhost:8080/gsd13` (or `http://your-computer-name:your-chosen-port/gsd13`). This gets you to a welcome page containing links to four servlets: the `test` servlet (this allows you to check that Tomcat is running properly); the standard `library` servlet which serves

localsite site with the default interface; the classic servlet which serves localsite using the classic or Greenstone 2-style interface; the gateway servlet, which serves gateway site with the default interface. The gateway site uses a SOAP connection to communicate with localsite, and demonstrates the library working in a distributed fashion.

1.2 How the library works

The standard library program is a Java servlet. We use the Tomcat servlet container to present the servlets over the web. Tomcat takes CGI-style URLs and passes the arguments to the servlet, which processes these and returns a page of HTML. As far as an end-user is concerned, a servlet is a Java version of a CGI program. The interaction is similar: access is via a web browser, using arguments in a URL.

Other types of interfaces can be used, such as Java GUI programs. See Section 5.3 for details about how to make these.

1.2.1 Restarting the library

The library program (actually Tomcat) can be restarted in Windows by closing the window, and restarting it from the Start menu. In Linux, you need to go to the gsd3 directory, and run `./gs3-launch.sh -shutdown`, then `./gs3-launch.sh`.

Tomcat must be restarted any time you make changes in the following for those changes to take effect:

- `$GSDL3HOME/web/WEB-INF/web.xml`
- `$GSDL3HOME/comms/jakarta/tomcat/conf/server.xml`
- any classes or jar files used by the servlets

Note: stdout and stderr for the servlets both go to

`$GSDL3HOME/comms/jakarta/tomcat/logs/catalina.out`

1.3 Directory structure

Table 1 shows the file hierarchy for Greenstone 3. The first part shows the common stuff which can be shared between Greenstone users—the source, libraries etc. The second part shows the file hierarchy for the gsd3/web directory, which comprises the gsd3 context for Tomcat, and is accessible via Tomcat. The main directories are for sites and interfaces: there can be several sites and interfaces per installation, and they are described in the following section.

1.4 Sites and interfaces

[local gs stuff (sites and interfaces) vs installed stuff (code)
where they live, whats the difference, what each contains.]

Sites and interfaces contain the content and presentation information, respectively,

Table 1: The Greenstone directory structure

directory	description
gsdl3	The main installation directory—gsdl3home can be changed to something more standard
gsdl3/src	Source code lives here
gsdl3/src/java/	java source code
gsdl3/packages	Imported packages from other systems e.g. MG, MGPP
gsdl3/lib	Shared library files
gsdl3/lib/java	Java jar files
gsdl3/resources	any resources that may be needed
gsdl3/resources/java	properties files for java resource bundles - used to handle all the language specific text This directory is on the class path, so any other Java resources can be placed here
gsdl3/resources/soap	soap service description files
gsdl3/resources/dtd	Greenstone 3 has trouble locating DTD files sometimes. They can go here
gsdl3/bin	executable stuff lives here
gsdl3/bin/script	some Perl and/or shell building scripts
gsdl3/comms	Communication packages: Tomcat and SOAP
gsdl3/docs	Documentation
gsdl3/web	This is where the web site is defined. Any static HTML files can go here. This directory is the Tomcat root directory.
gsdl3/web/WEB-INF	The web.xml file lives here (servlet configuration information for Tomcat)
gsdl3/web/WEB-INF/classes	Servlet classes go in here
gsdl3/web/sites	Contains directories for different sites—a site is a set of collections and services served by a single MessageRouter (MR). The MR may have connections (e.g. soap) to other sites
gsdl3/web/sites/localsite	An example site - the site configuration file lives here
gsdl3/web/sites/localsite/collect	The collections directory
gsdl3/web/sites/localsite/images	Site specific images
gsdl3/web/sites/localsite/transforms	Site specific transforms
gsdl3/web/interfaces	Contains directories for different interfaces - an interface is defined by its images and XSLT files
gsdl3/web/interfaces/default	The default interface
gsdl3/web/interfaces/default/images	The images for the default interface
gsdl3/web/interfaces/default/transforms	The XSLT files for the default interface

for the digital library. A site is comprised of a set of collections and possibly some site-wide services. An interface (in this web-based servlet context) is a set of images along with a set of XSLT files used for translating xml output from the library into an appropriate form—HTML in general.

One Greenstone 3 installation can have many sites and interfaces, and these can be paired in different combinations. One instantiation of a servlet uses one site and one interface, so every specified pairing results in a new servlet instance. For example, a single site might be served with two different interfaces. This provides different modes of access to the same content. e.g. HTML vs WML, or perhaps providing a completely different look and feel for different audiences. Alternatively, a standard interface may be used with many different sites—providing a consistent mode of access to a lot of different content.

Collections live in the `collect` directory of a site. Any collections that are found in this directory when the servlet is initialised will be loaded up and presented to the user. Collections require valid configuration files, but apart from this, nothing needs to be done to the site to use new collections. Collections added while Tomcat is running will not be noticed automatically. Either the server needs to be restarted, or a configuration request may be sent to the library, triggering a (re)load of the collection (this is described in Section 1.7).

There are two sites that come with the distribution: `localsite`, and `gateway`. `localsite` has several demo collections, while `gateway` has none. `gateway` specifies that a SOAP connection should be made to `localsite`. Getting this to work involves setting up a soap server for `localsite`: see Section 6 for details. There are also two interfaces provided in the distribution: `default` and `classic`. The default interface is a generic Greenstone 3 interface, while the `classic` interface aims to look like the old Greenstone 2 interface.

Each site and interface has a configuration file which specifies parameters for the site or interface—these are described in Section 1.6.

1.5 Configuring Tomcat

The file `SGSDL3HOME/web/WEB-INF/web.xml` contains the configuration information for Tomcat. It tells Tomcat what servlets to load, what initial parameters to pass them, and what web names map to the servlets. There are four servlets specified in `web.xml` (these correspond to the four servlet links in the welcome page for Greenstone 3): one is a test servlet that just prints “hello greenstone” to a web page. This is useful if you are having trouble getting Tomcat set up. The other three are the Greenstone library servlets described in Section 1.1.3, `library`, `classic` and `gateway`. Each servlet must specify which site and which interface to use. Having multiple servlets provides a way of serving different sites, or the same site with a different style of presentation. `Site_name` and `interface_name` are just two examples of initialisation parameters used by the library servlets. The full list is shown in Table 2.

For more details about Tomcat see Appendix B.

Table 2: Greenstone servlet initialisation parameters

name	sample value	description
gsdl3_home	/research/kjdon/gsd3	the base directory of the gsdl3 installation
site_name	localsite	the name of the site to use
interface_name	default	the name of the interface to use
library_name	library	the web name of the servlet
default_lang	en	the default language for the interface
receptionist_class	NZDLReceptionist	(optional) specifies an alternative Receptionist to use
messengerouter_class	NewMessageRouter	(optional) specifies an alternative MessageRouter to use
params_class	NZDLParams	(optional) specifies an alternative GSPParams class to use

1.6 Configuring a Greenstone library

Initial Greenstone 3 system configuration is determined by a set of configuration files, all expressed in XML. Each site has a configuration file that binds parameters for the site, `siteConfig.xml`. Each interface has a configuration file, `interfaceConfig.xml`, that specifies Actions for the interface. Collections also have several configuration files; these are discussed in Section 2.3. The configuration files are read in when the system is initialised, and their contents are cached in memory. This means that changes made to these files once the system is running will not take immediate effect. Tomcat needs to be restarted for changes to the interface configuration file to take effect. However, changes to the site configuration file can be incorporated sending a system command to the library. There are a series of system commands that can be sent to the library to induce reconfiguration of different modules, including reloading the whole site. This removes the need to restart the system to reflect these changes. These commands are described in Section 1.7.

1.6.1 Site configuration file

The file `siteConfig.xml` specifies the URI for the site (`localSiteName`), the HTTP address for site resources (`httpAddress`), any `ServiceClusters` that the site provides (for example, collection building), any `ServiceRacks` that do not belong to a cluster or collection, and a list of known external sites to connect to. Collections are not specified in the site configuration file, but are determined by the contents of the site's collections directory.

The HTTP address is used for retrieving resources from a site outside the XML protocol. Because a site is HTTP accessible through Tomcat, any files (e.g. images) belonging to that site or to its collections can be specified in the HTML of a page by a URL. This avoids having to retrieve these files from a remote site via the XML

```

<siteConfig>
  <localSiteName value="org.greenstone.localsite"/>
  <httpAddress value="http://localhost:8080/gsd13/sites/localsite"/>
  <serviceClusterList/>
  <serviceRackList/>
  <siteList/>
</siteConfig>

<siteConfig>
  <localSiteName value="org.greenstone.gsd11"/>
  <httpAddress value="http://localhost:8080/gsd13/sites/gsd11"/>
  <serviceClusterList>
    <serviceCluster name="build">
      <metadataList>
        <metadata name="Title">Collection builder</metadata>
        <metadata name="Description">Builds collections in a
          gsd12-style manner</metadata>
      </metadataList>
      <serviceRackList>
        <serviceRack name="GS2Construct"/>
      </serviceRackList>
    </serviceCluster>
  </serviceClusterList>
  <siteList>
    <site name="org.greenstone.localsite"
      address="http://localhost:8080/soap/servlet/rpcrouter"
      type="soap"/>
  </siteList>
</siteConfig>

```

Figure 1: Two sample site configuration files

protocol¹.

Figure 1 shows two example site configuration files. The first example is for a rudimentary site with no site-wide services, which does not connect to any external sites. The second example is for a site with one site-wide service cluster - a collection building cluster. It also connects to the first site using SOAP. These two sites happen to be running on the same machine, which is why they can use `localhost` in the address. For site `gsd11` to talk to site `localsite`, a SOAP server must be run for `localsite`. The address of the SOAP server, in this case, is `http://localhost:8080/soap/servlet/rpcrouter`.

¹Currently, sites live inside the Tomcat `gsd13` root context, and therefore all their content is accessible over HTTP via the Tomcat address. We need to see if parts can be restricted. Also, if we use a different protocol, then resources from remote sites may need to come through the XML. Also, if we are running locally without using Tomcat, we may want to get them via `file://` rather than `http://`.

1.6.2 Interface configuration file

The interface configuration file `interfaceConfig.xml` lists all the actions that the interface knows about at the start (other ones can be loaded dynamically). Actions create the web pages for the library: there is generally one Action per type of page. For example, a query action produces the pages for searching, while a document action displays the documents. The configuration file specifies what short name each action maps to (this is used in library URLs for the `a` (action) parameter) e.g. QueryAction should use `a=q`. If the interface uses XSLT, it specifies what XSLT file should be used for each action and possibly each subaction. This makes it easy for developers to implement and use different actions and/or XSLT files without recompilation. The server must be restarted, however.

It also lists all the languages that the interface text files have been translated into. These have a `name` attribute, which is the ISO code for the language, and a `displayElement` which gives the language name in that language (note that this file should be encoded in UTF-8). This language list is used on the Preferences page to allow the user to change the interface language. Details on how to add a new language to a Greenstone 3 library are shown in Section 2.6.

1.7 Run-time re-initialisation

When Tomcat is started up, the site and interface configuration files are read in, and actions/services/collections loaded as necessary. The configuration is then static unless Tomcat is restarted, or re-configuration commands issued.

There are several commands that can be issued to Tomcat to avoid having to restart the server. These can reload the entire site, or just individual collections. Unfortunately at present there are no commands to reconfigure the interface, so if the interface configuration file has changed, Tomcat must be restarted for those changes to take effect. Similarly, if the Java classes are modified, Tomcat must be restarted then too.

Currently, the runtime configuration commands can only be accessed by typing arguments into the URL; there is no nice web form yet to do this.

The arguments are entered after the `library?` part of the URL. There are three types of commands: `configure`, `activate`, `deactivate`². These are specified by `a=s&sa=c`, `a=s&sa=a`, and `a=s&sa=d`, respectively (`a` is action, `sa` is subaction). By default, the requests are sent to the MessageRouter, but they can be sent to a collection/cluster by the addition of `sc=xxx`, where `xxx` is the name of the collection or cluster. Table 3 describes the commands and arguments in a bit more detail.

²There is no security for these commands yet in Greenstone, so the deactivate/delete command is disabled

```

<interfaceConfig>
  <actionList>
    <action name='p' class='PageAction'>
      <subaction name='home' xslt='home.xsl'/>
      <subaction name='about' xslt='about.xsl'/>
      <subaction name='help' xslt='help.xsl'/>
      <subaction name='pref' xslt='pref.xsl'/>
    </action>
    <action name='q' class='QueryAction' xslt='basicquery.xsl'/>
    <action name='b' class='GS2BrowseAction' xslt='classifier.xsl'/>
    <action name='a' class='AppletAction' xslt='applet.xsl'/>
    <action name='d' class='DocumentAction' xslt='document.xsl'/>
    <action name='xd' class='XMLDocumentAction'>
      <subaction name='toc' xslt='document-toc.xsl'/>
      <subaction name='text' xslt='document-content.xsl'/>
    </action>
    <action name='pr' class='ProcessAction' xslt='process.xsl'/>
    <action name='s' class='SystemAction' xslt='system.xsl'/>
  </actionList>
  <languageList>
    <language name="en">
      <displayItem name='name'>English</displayItem>
    </language>
    <language name="fr">
      <displayItem name='name'>Français</displayItem>
    </language>
    <language name='es'>
      <displayItem name='name'>Español</displayItem>
    </language>
  </languageList>
</interfaceConfig>

```

Figure 2: Default interface configuration file

Table 3: Example run-time configuration arguments.

<code>a=s&sa=c</code>	reconfigures the whole site. Reads in <code>siteConfig.xml</code> , reloads all the collections. Just part of this can be specified with another argument <code>ss</code> (system subset). The valid values are <code>collectionList</code> , <code>siteList</code> , <code>serviceList</code> , <code>clusterList</code> .
<code>a=s&sa=c&sc=XXX</code>	reconfigures the <code>XXX</code> collection or cluster. <code>ss</code> can also be used here, valid values are <code>metadataList</code> and <code>serviceList</code> .
<code>a=s&sa=a</code>	(re)activate a specific module. Modules are specified using two arguments, <code>st</code> (system module type) and <code>sn</code> (system module name). Valid types are <code>collection</code> , <code>cluster</code> <code>site</code> .
<code>a=s&sa=d</code>	deactivate a module. <code>st</code> and <code>sn</code> can be used here too. Valid types are <code>collection</code> , <code>cluster</code> , <code>site</code> , <code>service</code> . Modules are removed from the current configuration, but will reappear if Tomcat is restarted.
<code>a=s&sa=d&sc=XXX</code>	deactivate a module belonging to the <code>XXX</code> collection or cluster. <code>st</code> and <code>sn</code> can be used here too. Valid types are <code>service</code> .

2 Using Greenstone 3

Once Greenstone 3 is installed, the sample collections can be accessed. The installation comes with several example collections, and Section 2.1 describes these collections and how to use them. Section 2.2 describes how to build new collections.

2.1 Using a collection

A collection typically consists of a set of documents, which could be text, HTML, word, PDF, images, bibliographic records etc, along with some access methods, or “services”. Typical access methods include searching or browsing for document identifiers, and retrieval of content or metadata for those identifiers. Searching involves entering words or phrases and getting back lists of documents that contain those words. The search terms may be restricted to particular fields of the document.

Browsing involves navigating pre-defined hierarchies of documents, following links of interest to find documents. The hierarchies may be constructed on different metadata fields, for example, alphabetical lists of Titles, or a hierarchy of Subject classifications. Clicking on a bookshelf icon takes you to a lower level in the hierarchy, while clicking on a book or page icon takes you to a document.

In the standard interface that comes with Greenstone 3³, collections in a digital library are presented in the following manner. The ‘home’ page of the library shows a list of all the public collections in that library. Clicking on a collection link takes you to the home page for the collection, which we call the collection’s ‘about’ page. The standard page banner looks something like that shown in Figure 3.



Figure 3: A sample collection page banner

The image at the top left is a link to the collection’s home page. The top right has buttons to link to the library home page, help and preferences pages. All the available services are arrayed along a navigation bar, along the bottom of the banner. Clicking on a name accesses that service.

Search type services generally provide a form to fill in, with parameters including what field or granularity to search, and the query itself. Clicking the search button carries out the search, and a list of matching documents will be displayed. Clicking on the icons in the result list takes you to the document itself.

³of course, this is all customisable

Once you are looking at a document, clicking the open book icon at the top of the document, underneath the navigation bar, will take you back to the service page that you accessed the document from.

2.2 Building a collection

There are three ways to get a new collection into Greenstone 3. The first is to build it using the Greenstone 3 command line building process. The second way is to use the Greenstone Librarian Interface to build a new collection. This creates a collection in a Greenstone 3 context, but uses the Greenstone 2 Perl collection building process. The third way is to import a pre-built Greenstone 2 collection.

Collections live in the collect directory of a site. As described in Section 1.4, there can be several sites per Greenstone 3 installation. The collect directory is at `$GSDL3HOME/web/sites/site-name/collect`, where `site-name` is the name of the site you want your new collection to belong to.

The following three sections describe how to create a collection from scratch, using command line and GLI building, and how to import a Greenstone 2 collection. Once a collection has been built (and is located in the collect directory), the library server needs to be notified that there is a new collection. This can be accomplished in two ways⁴. If you are the library administrator, you can restart Tomcat. The library servlet will then be created afresh, and will discover the new collection when it scans the collect directory for the collection list. Alternatively, an activate collection command can be issued to the servlet, using the arguments `a=s&sa=a&st=collection&sn=collname`, where `collname` should be replaced with the collection name—this tells the library program to (re)load the `collname` collection.

2.2.1 Creating a collection from scratch

Building native Greenstone 3 collections is done using the `gs3-build.sh` script, with the `collectionConfig.xml` file controlling how the building is done. There are a number of considerations in building a collection: what documents appear in the collection, how they are indexed for searching, which classifications are used for browsing, etc.

Firstly, the documents that comprise the collection should be placed in the import subdirectory. At present, only documents in this directory will appear in the collection. Documents can be organised into sub folders inside the import directory. [TODO: describe the kinds of documents that can be added, something about METS files?]

Metadata for documents can be added using `metadata.xml` files. These files have already been used in Greenstone 2, and the format is the same in Greenstone 3. A `metadata.xml` file has a root element of `<DirectoryMetadata>`. This encloses a series of `<FileSet>` items. Neither of these tags has any attributes. Each

⁴and eventually there will also probably be automatic polling for new collections

<FileSet> item includes two parts: firstly, one or more <FileName> tags, each of which encloses a regular expression to identify the files which are to be assigned the metadata. Only files in the same directory as the metadata.xml, or in one of its child directories, will be selected. The filename tag encloses the regular expression as text, e.g.:

```
<FileName>example</FileName>
```

This would match any file containing the text 'example' in its name. The second part of the <FileSet> item is a <Description> item. The <Description> tag has no attributes, but encloses one or more <Metadata> tags. Each <Metadata> tag contains one metadata item, i.e. a label to describe the metadata and a corresponding value. The <Metadata> tag has one compulsory attribute: "name". This attribute gives the metadata label to add to the document. Each <Metadata> tag also has an optional attribute: "mode". If this attribute is set to "accumulate" then the value is added to the document, and any existing values for that metadata item are retained. If the attribute is set to "set" or is omitted, then any existing value of the metadata item will be deleted.

Figure 4 shows an example metadata.xml file. Here, only one file pattern is found in each file set. However, the <Description> tag contains a number of separate metadata items. Note that the <Title> metadata does not have the mode=accumulate attribute. This means that when the title is assigned to a document, its existing <Title> information will be lost.

The basic means of finding documents in Greenstone is search. Options for building the search indexes include which indexer to use, what granularity to use for the indexes (e.g. whether to index documents as a whole, or sections of documents), what content the index should have (the whole text of the document or one or many metadata fields). Section-level indexes allow a reader to recall part of a document (for instance, a chapter) rather than the entire document. However, Greenstone 3 must be able to identify the internal structure of the document to achieve this. The degree to which structure can be found varies from file format to file format.

An alternative means of finding documents is through browsing. Greenstone can create pre-defined browsing hierarchies based on document metadata. Each browsing structure is called a classifier. Options for building classifiers include what type of classifier to use (linear list or multi-level hierarchy), what metadata to build the classifier on, e.g. Title, Author etc.

The collectionConfig.xml file controls the all of these options for collection building, and the format is described in Section 2.3.

To build a collection, place the source documents and optional metadata.xml file(s) in the import directory, place the collectionConfig.xml file in the etc directory, and execute `gs3build.sh/bat sitename collectionname`. The process will run, placing the new indexes in the `building` subdirectory of the collection's directory. You must have `mysql` running before you start building—running `gs3-launch.sh/bat` will start up the MySQL server as well as `tomcat`.

```

<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE DirectoryMetadata SYSTEM "http://greenstone.org/dtd/DirectoryMetadata
/1.0/DirectoryMetadata.dtd">
<DirectoryMetadata>
  <FileSet>
    <FileName>ec160e</FileName>
    <Description>
      <Metadata name="Title">The Courier - No.160 - Nov - Dec 1996 -
        Dossier Habitat - Country reports: Fiji , Tonga (ec160e)</Metadata>
      <Metadata mode="accumulate" name="Language">English</Metadata>
      <Metadata mode="accumulate" name="Subject">Settlements and housing:
        general works incl. low- cost housing, planning techniques, surveying,
        etc.</Metadata>
      <Metadata mode="accumulate" name="Subject">The Courier ACP 1990 - 1996
        Africa-Caribbean-Pacific - European Union</Metadata>
      <Metadata mode="accumulate" name="Organization">EC Courier</Metadata>
      <Metadata mode="accumulate" name="AZList">T.1</Metadata>
    </Description>
  </FileSet>
  <FileSet>
    <FileName>b22bue</FileName>
    <Description>
      <Metadata name="Title">Butterfly Farming in Papua New Guinea
        (b22bue)</Metadata>
      <Metadata mode="accumulate" name="Language">English</Metadata>
      <Metadata mode="accumulate" name="Subject">Other animals (micro-
        livestock, little known animals, silkworms, reptiles, frogs,
        snails, game, etc.)</Metadata>
      <Metadata mode="accumulate" name="Organization">BOSTID</Metadata>
      <Metadata mode="accumulate" name="AZList">T.1</Metadata>
      <Metadata mode="accumulate" name="Keyword">start a butterfly farm
        </Metadata>
    </Description>
  </FileSet>
</DirectoryMetadata>

```

Figure 4: Sample metadata.xml file

Once the build process is complete, the building directory should be renamed to index (after deleting or renaming the existing index directory, if any), and Tomcat prompted to reload the collection—either by restarting the server, or by sending an activate collection command to the library servlet.

2.2.2 Using the Librarian Interface

The Greenstone Librarian Interface (GLI) can be used to create Greenstone 2 style collections for Greenstone 3. It can be started under Windows by selecting Greenstone Librarian Interface from the Greenstone 3 Digital Library menu in the Program Files section of the Start menu. On Linux, run `./gli4gs3.sh` from the `gsdl3/gli` directory.

Currently, the GLI works almost exactly the same as for Greenstone 2⁵. Collection configuration is done in a Greenstone 2 manner. The main difference is that Greenstone 3 has different sites and interfaces and servlets, whereas Greenstone 2 has a single collect directory, and a single runtime cgi program.

The GLI for Greenstone 3 has a couple of new configuration parameters: site and servlet. It operates within a single site—you can edit, delete, create new collections within this site. A servlet is also specified for that site—this is used when previewing a collection. While you are working in one site, you cannot edit collections from another site. However, you can base a collection on one from another site. To change the working site and/or servlet, go to Preferences->Connection in the File menu. By default, the GLI will use site `localsite`, and servlet `library`.

Collection building using the GLI will use the Greenstone 2 Perl scripts and plugins. At the conclusion of the Greenstone 2 build process, a conversion script will be run to create the Greenstone 3 configuration files. This means that format statements are no longer 'live'—changing these will require changes to the Greenstone 3 config files. You can either rebuild the collection through the GLI (may take a while), or run the conversion script directly (see following section).

Detailed instructions about using the GLI can be found in Sections 3.1 and 3.2 of the Greenstone 2 User's Guide (`GS2-User-en.pdf`). This can be found in your Greenstone 2 installation, or in the `gsdl3/docs/manual` directory if you have installed Greenstone 3 from a distribution.

2.2.3 Importing a Greenstone 2 collection

Pre-built Greenstone 2 collections can also be used in Greenstone 3⁶. The collection folder should be copied to the collect directory of the site it is to appear in (or a symbolic link may be used if possible). The Greenstone 3 run time system requires different configuration files for a collection, so you need to run a conversion script.

⁵Eventually the GLI will be modified to use native Greenstone 3 config files and collection building

⁶For information about the Greenstone 2 software, and how to build collections using it, visit www.greenstone.org

All this does is create the new `collectionConfig.xml` and `buildConfig.xml` from the old `collect.cfg` and `build.cfg` files. It does not change the collection in any way, so it can still be used by Greenstone 2 software.

The conversion script is `convert_coll_from_gs2.pl`. To run it, make sure you have run `source setup.bash` (or `setup` in Windows) in your top-level `gsdl` directory of the Greenstone 2 installation (as well as running the standard `gs3-setup` command). Then you need to specify the path to the `collect` directory and the collection name as parameters to the conversion script. For example,

```
convert_coll_from_gs2.pl -collectdir
    $GSDL3HOME/web/sites/localsite/collect demo
```

The script attempts to create Greenstone 3 format statements from the old Greenstone 2 ones. The conversion may not always work properly, so if the collection looks a bit strange under Greenstone 3, you should check the format statements. Format statements are described in Section 2.5.

Once again, to have the collection recognised by the library servlet, you can either restart Tomcat, or load it dynamically.

2.3 Collection configuration files

Each collection has two, or possibly three, configuration files, `collectionConfig.xml` and `buildConfig.xml`, and optionally `collectionInit.xml`, that give metadata, display and other information for the collection.⁷ The first includes user-defined presentation metadata for the collection, such as its name and the *About this collection* text; gives formatting information for the collection display; and also gives instructions on how the collection is to be built. The second is produced by the build-time process and includes any metadata that can be determined automatically. It also includes configuration information for any `ServiceRacks` needed by the collection.

All the configuration files should be encoded using UTF-8.

2.3.1 collectionInit.xml

This optional file is only used for non-standard, customised collections. It specifies the class name of the non-standard collection class. The only syntax so far is the class name:

```
<collectionInit class="XMLCollection"/>
```

Section 5.6 describes an example collection where this file is used. Depending on the type of collection that this is used for, one or both of the other config files may not be needed.

⁷For collections imported from Greenstone 2, `collectionConfig.xml` and `buildConfig.xml` are generated from `collect.cfg` and `build.cfg`.

2.3.2 collectionConfig.xml

The collection configuration file is where the collection designer (e.g. a librarian) decides what form the collection should take. This includes the collection metadata such as title and description, and also includes what indexes and browsing structures should be built. The format of `collectionConfig.xml` is still under consideration. However, Figure 5 shows the parts of it that have been defined so far.

Display elements for a collection or metadata for a document can be entered in any language—use `lang='en'` attributes to metadata elements to specify which language they are in.

The `<metadataList>` element specifies some collection metadata, such as creator. The `<displayItemList>` specifies some language dependent information that is used for collection display, such as collection name and short description. These `displayItem` elements can be specified in different languages.

The `<search>` element specifies what indexes should be built, and provides some display and formatting information for each one. Search has an attribute, `type`, which specifies which indexer to be used for indexing. Currently, `mg` and `mgpp[??]` are available. If `type` is not specified, `mg` is used. Multiple search elements may be specified, if more than one indexer is to be used. (Note, this is not yet recognised by the run-time system.)

Search indexes appear as individual `<index>` elements within the `<search>` element. Some choices for the index are made using attributes of the element itself, and some through child elements.

Each index must have a unique name, which is used to identify it within Greenstone 3. The name is given as an attribute of the `<index>` element.

The other choices are described using child elements of `<index>`. The `<level>` tag indicates the index level and the `<field>` tag the text to be used. The `<level>` tag can contain one of document, section or paragraph, while the `<field>` tag can contain “text” or the name of a metadata field. If the `<level>` tag is omitted, the default setting is to index by document, and if the `<field>` tag is omitted, the default setting is to index the document text.

Example index specifications include:

[NOTE: I think we shouldn't have default level and field and that it must be specified—kjdon]

To index only the title of each separate document in the collection:

```
<index name="dtt">
  <level>document</level>
  <field>dc:title</field>
</index>
```

...in this case the `<field>` tag refers to the “title” metadata item, found in the Dublin Core namespace. The `mg` search engine would be used on this index.

Alternatively, to index the full document texts by section:

```
<index name="stx">
```

```

<collectionConfig xmlns:gsf="http://www.greenstone.org/configformat"
  xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <metadataList>
    <metadata name="creator">greenstone@cs.waikato.ac.nz</metadata>
  </metadataList>
  <displayItemList>
    <displayItem name="name" lang="en">Greenstone 3 demo</displayItem>
    <displayItem name="icon" lang="en">gs3demo.gif</displayItem>
    <displayItem name="smallicon" lang="en">gs3demosm.gif</displayItem>
    <displayItem name="description" lang="fr">Il s'agit d'une collection
      de démonstration pour le logiciel Greenstone. Elle contient
      seulement un petit échantillon des Bibliothèques humanitaires
      pour le Développement (11 documents).</displayItem>
    <displayItem name="description" lang="en">This is a demonstration
      collection for the Greenstone digital library software. It contains
      a small subset (11 books) of the Humanity Development Library. It
      is built with mg using Greenstone 3 native building.</displayItem>
  </displayItemList>
  <search type='mg'>
    <index name="i1">
      <field>text</field>
      <level>document</level>
      <displayItem name='name' lang="en">entire documents</displayItem>
      <displayItem name='name' lang="fr">documents entiers</displayItem>
      <displayItem name='name' lang="es">documentos enteros</displayItem>
    </index>
    <index name="i2">
      <field>text</field>
      <level>section</level>
      <displayItem name='name' lang="en">chapters</displayItem>
      <displayItem name='name' lang="fr">chapitres</displayItem>
      <displayItem name='name' lang="es">capítulos</displayItem>
    </index>
    <format>
      <gsf:template match="documentNode">
        <td valign='top'><gsf:link><gsf:icon/></gsf:link></td>
        <td><gsf:metadata name='Title' /></td>
      </gsf:template>
    </format>
  </search>
  <browse>
    <classifier name="CL1" type="AZList" horizontalAtTop='true'>
      <field>Title</field>
      <sort>Title</sort>
      <displayItem name='name' lang='en'>Titles</displayItem>
    </classifier>
    <classifier name="CL2" type="Hierarchy">
      <field>Organization</field>
      <sort>Title</sort>
      <displayItem name='name' lang='en'>Organizations</displayItem>
      <file URL="/research/kjdon/home/gsd13/web/sites/localsite/collect/
        gs3test/etc/org.xml"/>
    </classifier>
    <classifier name="CLKeyword" type="Hierarchy">
      <field>Keyword</field>
      <sort>Title</sort>
      <displayItem name='name' lang='en'>HowTo</displayItem>
      <file URL="/research/kjdon/home/gsd13/web/sites/localsite/collect/
        gs3test/etc/keyword.xml"/>
    <format>
      <gsf:template match="documentNode">
        <br /><gsf:link><gsf:metadata name='Keyword' />
        </gsf:link></gsf:template>
      </format>
    </classifier>
  </browse>

```

```
<level>section</level>
</index>
```

...or...

```
<index name="stx">
  <level>section</level>
  <field>text</field>
</index>
```

...in the first example, the `<field>` tag is not explicitly defined, and would default to 'text', whereas it is explicitly set to 'text' in the second example. As they are of the same name, they should not appear in the same `collectionConfig.xml` file.

Moving onto `<classifier>` items, the format is broadly similar to `<index>` items, but with a couple of different choices. Firstly, each classifier should have "name" and "type" attributes. In the case of `<classifier>` items the "type" attribute identifies the type of classifier it is. At present, this should either be "Hierarchy" or "AZList".

The remaining choices for the classifier should follow as child elements of the `<classifier>` element. The `<file>` element should contain the name of the file that describes the classifier as its "URL" attribute. The format of this file varies from classifier type to classifier type. The `<field>` element identifies the name of the field to index. More than one `<field>` element may appear if two or more metadata fields are to be used with the classifier. Finally, the `<sort>` item identifies another metadata field which the items within one classifier node are to be ordered. Unlike the `<index>` element, the `<classifier>` element does not have default, assumed values for its children.

Figure 6 shows the format of the file for a Hierarchy classifier. [TODO add a description]

Inside the `<search>` and `<browse>` elements, `<displayItem>` elements are used to provide titles for the indexes or classifiers, while `<format>` elements provide formatting instructions, typically for a document or classifier node in a list of results. Placing the `<format>` instructions at the top level in the search or browse element will apply the format to all the indexes or classifiers, while placing it inside an individual index or classifier element will restrict that formatting instruction to that item.

The `<display>` element contains optional formatting information for the display of documents. Templates that can be specified here include `documentHeading`, `DocumentContent`, and other information that could be specified (in a yet to be decided format) are things such as whether or not to display the cover image, table of contents etc.

Format elements are described in Section 2.5.

2.4 buildConfig.xml

The file `buildConfig.xml` is produced by the collection building process. Generally it is not necessary to look at this file, but it can be useful in determining what

```

<Hierarchy>
  <Classification>
    <Name>ACCU</Name>
    <Path>1</Path>
    <Description>ACCU</Description>
  </Classification>
  <Classification>
    <Name>Agenda 21</Name>
    <Path>2</Path>
    <Description>Agenda 21</Description>
  </Classification>
  <Classification>
    <Name>FAO</Name>
    <Path>3</Path>
    <Description>FAO</Description>
    <Children>
      <Classification>
        <Name>FAO Better Farming series</Name>
        <Path>3.1</Path>
        <Description>FAO Better Farming Series</Description>
      </Classification>
    </Children>
  </Classification>
</Hierarchy>

```

Figure 6: Sample Hierarchy classifier file

went wrong if the collection doesn't appear quite the way it was planned.

It contains metadata and other information about the collection that can be determined automatically, such as the number of documents it contains. It also includes a list of ServiceRack classes that are required to provide the services that have been built into the collection. The serviceRack names are Java classes that are loaded dynamically at runtime. Any information inside the serviceRack element is specific to that service—there is no set format. Figure 7 shows an example. This configuration file specifies that the collection should load up 3 ServiceRacks: `GS2MGPPRetrieve`, `GS2MGPPSearch`, and `PhindPhraseBrowse`. The contents of each `<serviceRack>` element are passed to the appropriate ServiceRack objects for configuration. The `collectionConfig.xml` file content is also passed to the ServiceRack objects at configure time—the `format` and `displayItem` information is used directly from the `collectionConfig.xml` file rather than added into `buildConfig.xml` during building. This enables formatting and metadata changes in `collectionConfig.xml` to take effect in the collection without rebuilding being necessary. However, as these files are cached, the collection needs to be reloaded for the changes to appear in the library.

```

<buildConfig xmlns:gsf="http://www.greenstone.org/configformat">
  <metadataList>
    <metadata name="numDocs">11</metadata>
  </metadataList>
  <serviceRackList>
    <serviceRack name="GS2MGPPRetrieve">
      <defaultLevel name="Sec" />
      <classifierList>
<classifier name="CL1" content="Subject" />
<classifier name="CL2" content="Title" horizontalAtTop="true" />
<classifier name="CL3" content="Organization" />
<classifier name="CL4" content="Keyword" />
      </classifierList>
    </serviceRack>
    <serviceRack name="PhindPhraseBrowse" />
    <serviceRack name="GS2MGPPSearch">
      <defaultLevel name="Sec" />
      <levelList>
<level name="Doc" />
<level name="Sec" />
<level name="Para" />
      </levelList>
      <fieldList>
<field shortname="ZZ" name="allfields" />
<field shortname="TX" name="text" />
<field shortname="TI" name="Title" />
<field shortname="SU" name="Subject" />
<field shortname="ORG" name="Organization" />
<field shortname="SO" name="Source" />
      </fieldList>
      <searchTypeList>
<searchType name="plain" />
<searchType name="form" />
      </searchTypeList>
      <defaultIndex name="idx" />
      <indexList>
<index name="idx" />
      </indexList>
    </serviceRack>
  </serviceRackList>
</buildConfig>

```

Figure 7: Sample buildConfig.xml file (mgppdemo collection)

2.5 Formatting the collection

Part of collection design involves deciding how the collection should look. Greenstone 3 has a default 'look' for a collection, so this is optional. However, the default may not suit the purposes of some collections, so many parts to the look of a collection can be determined by the collection designer.

In standard Greenstone 3, the library is served to a web browser by a servlet, and the HTML is generated using XSLT. XSLT templates are used to format all the parts of the pages. These templates can be overridden by including them in the `collectionConfig.xml` file. Some commonly overridden templates are those for formatting lists: search results list, classifier browsing hierarchies, and for parts of the document display.

Real XSLT templates for formatting search results or classifier lists are quite complicated, and not at all easy for a new user to write. For example, the following is a sample template for formatting a classifier list, to show Keyword metadata as a link to the document.

```
<xsl:template match="documentNode" priority="2"
  xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:param name="collName"/>
  <td><a href="{\$library_name}?a=d&amp;c={\$collName}&amp;
    d={@nodeID}&amp;dt={@docType}"><xsl:value-of
    select="metadataList/metadata[@name='Keyword']"/></a>
  </td>
</xsl:template>
```

To write this, the user would need to know that:

- the variable `$library_name` exists,
- the collection name is passed in as a parameter called `collName`
- metadata for a document is found in a `<metadataList>` and that its form is `<metadata name="Keyword">the value</metadata>`
- the arguments needed for the link to the document are `a`, `sa`, `c`, `d`, `a`, `dt`.

Since XSLT is written in XML, we can use XSLT to transform XML into XSLT. Greenstone 3 provides a simplified set of formatting commands, written in XML, which will be transformed into proper XSLT. The user specifies a `<gsf:template>` for what they want to format—these typically match `documentNode` or `classifierNode` (for node in a classification hierarchy).

The template at the start of this section can be represented as:

```
<gsf:template match='documentNode'>
  <td><gsf:link><gsf:metadata name='Keyword' /></gsf:link></td>
</gsf:template>
```


Table 4: Format elements for GSF format language

Element	Description
<code><gsf:text/></code>	The document's text
<code><gsf:link>...</gsf:link></code>	The HTML link to the document itself
<code><gsf:link type='document'>...</gsf:link></code>	Same as above
<code><gsf:link type='classifier'>...</gsf:link></code>	A link to a classification node (use in classifierNode templates)
<code><gsf:link type='source'>...</gsf:link></code>	The HTML link to the original file—set for documents that have been converted from e.g. Word, PDF, PS
<code><gsf:icon/></code>	An appropriate icon
<code><gsf:icon type='document' /></code>	same as above
<code><gsf:icon type='classifier' /></code>	bookshelf icon for classification nodes
<code><gsf:icon type='source' /></code>	An appropriate icon for the original file e.g. Word, PDF icon
<code><gsf:metadata name='Title' /></code>	The value of a metadata element for the current document or section, in this case, Title
<code><gsf:metadata name='Title' select='select-type' [separator='y' multiple='true'] /></code>	A more extended selection of metadata values. The select field can be one of those shown in Table 5. There are two optional attributes: separator gives a String that will be used to separate the fields, default is “, “, and if multiple is set to true, looks for multiple values at each section.
<code><gsf:choose-metadata></code> <code><gsf:metadata name='metaA' /></code> <code><gsf:metadata name='metaB' /></code> <code><gsf:metadata name='metaC' /></code> <code></gsf:choose-metadata></code>	A choice of metadata. Will select the first existing one. the metadata elements can have the select, separator and multiple attributes like normal.
<code><gsf:switch preprocess='preprocess-type'></code> <code><gsf:metadata name='Title' /></code> <code><gsf:when test='test-type' test-value='xxx'>...</gsf:when></code> <code><gsf:when test='test-type' test-value='yyy'>...</gsf:when></code> <code><gsf:otherwise>...</gsf:otherwise></code> <code></gsf:switch></code>	switch on the value of a particular metadata - the metadata is specified in gsf:metadata, has the same attributes as normal.

Table 5: Select types for metadata format elements

Select Type	Description
current	The current section
parent	The immediate parent section
ancestors	All the parents back to the root (topmost) section
root	The root or topmost section
siblings	All the sibling sections
children	The immediate child sections of the current section
descendents	All the descendent sections

Table 4 shows the set of 'gsf' (Greenstone Format) elements. If you have come from a Greenstone 2 background, Appendix D shows Greenstone 2 format elements and their equivalents in Greenstone 3 .

The `<gsf:metadata>` elements are used to output metadata values. The simplest case is `<gsf:metadata name='Title'/>`—this outputs the Title metadata for the current document or section. Namespaces are important here: if the Title metadata is in the Dublin Core (dc) namespace, then the element should look like `<gsf:metadata name='dc.Title'/>`. There are three other attributes for this element. The attribute `multiple` is used when there may be more than one value for the selected metadata. For instance, one document may fall into several classification categories, and therefore may have multiple Subject metadata values. Adding `multiple='true'` to the `<gsf:metadata>` element will retrieve all values, not just the first one. Multiple values are separated by commas by default. The `separator` attribute is used to change the separating string. For example, adding `separator=': '` to the element will separate all values by a colon and a space.

Sometimes you may want to display metadata values for sections other than the current one. For example, in the `mgppdemo` collection, in a search list we display the Titles of all the enclosing sections, followed by the Title of the current section, all separated by semi-colons. The display ends up looking something like: *Farming snails 2; Starting out; Selecting your snails* where *Selecting your snails* is the Title of the section in the results list, and *Farming snails 2* and *Starting out* are the Titles of the enclosing sections. The `select` attribute is used to display metadata for sections other than the current one. Table 5 shows the options available for this attribute. The `separator` attribute is used here also, to specify the separating text.

To get the previous metadata, the format statement would have the following in it:

```
<gsf:metadata name='Title' select='ancestors' separator='; '/>
  <gsf:metadata name='Title'/>
```

The `<gsf:choose-metadata` element selects the first available metadata value from the list of options.

```
<gsf:choose-metadata>
  <gsf:option name='dc.Title'/>
  <gsf:option name='dls.Title'/>
```

```
<gsf:option name='Title' />
</gsf:choose-metadata>
```

This will display the `dc.Title` metadata if available, otherwise it will use the `dc.Title` metadata if available, otherwise it will use the `Title` metadata. If there are no values for any of these metadata elements, then nothing will be displayed.

The `<gsf:switch>` element allows different formatting depending on the value of a specified metadata element. For example, the following switch statement could be used to display a different icon for each document in a list depending on which organisation it came from.

```
<gsf:switch metadata='Organization' preprocess='toLower;stripSpace'>
  <gsf:when test='equals' test-value='bostid'>
    <!-- output BOSTID image --></gsf:when>
  <gsf:when test='equals' test-value='worldbank'>
    <!-- output world bank image --></gsf:when>
  <gsf:otherwise><!-- output default image--></gsf:otherwise>
</gsf:switch>
```

Preprocessing of the metadata value is optional. The preprocess types are `toLower` (make the value lowercase), `toUpper` (make the value uppercase), `stripSpace` (removes any whitespace from the value). These operations are carried out on the value of the selected metadata before the test is carried out. Multiple processing types can be specified, separated by `;` and they will be applied in the order specified (from left to right).

Each option specifies a test and a test value. Test values are just text. Tests include `startsWith`, `contains`, `exists`, `equals`, `endsWith`. `Exists` doesn't need a test value. Having an `otherwise` option ensures that something will be displayed even when none of the tests match.

If none of the `gsf` elements meets your needs for formatting, XSLT can be entered directly into the format element, giving the collection designer full flexibility over how the collection appears.

The collection specific templates are added into the configuration file `collectionConfig.xml`. Any templates found in the XSLT files can be overridden. The important part to adding templates into the configuration file is determining where to put them. Formatting templates cannot go just anywhere—there are standard places for them. Figure 8 shows the positions that templates can occur.

There are also formatting instructions that are not templates but are options. These are described in Table 6. They are entered into the configuration file like `<gsf:option name='coverImages' value='false' />`

Note, format templates are added into the XSLT files before transforming, while the options are added into the page source, and used in tests in the XSLT.

2.6 Customising the interface

Format statements in the collection configuration files provide a way to change small parts of the collection display. For large scale customisations to a collection,

```

<collectionConfig>
  <metadataList/>
  <displayItemList/>
  <search>
    <format> <!--Put here templates related to searching and
      the query page. The common one is the documentNode
      template -->
    <gsf:template match='documentNode'>...</gsf:template>
  </format>
</search>
<browse>
  <classifier name='xx'>
    <format><!-- put here templates related to formatting a
      particular classifier page. Common ones are documentNode
      and classifierNode templates-->
    <gsf:template match='documentNode'>...</gsf:template>
    <gsf:template match='classifierNode'>...</gsf:template>
    <gsf:template match='classifierNode' mode='horizontal'>...
      </gsf:template>
  </format>
</classifier>
<classifier>...</classifier>
<format><!-- formatting for all the classifiers. these will
  be overridden by any classifier specific formatting
  instructions --></format>
</browse>
<display>
  <format><!-- here goes any formatting relating to the display
    of the documents. These are generally named templates,
    and format options -->
  <gsf:template name='documentContent'>...</gsf:template>
  <gsf:option name='TOC' value='true' />
  </format>
</display>
</collectionConfig>

```

Figure 8: Places for format statements

Table 6: Formatting options

option name	values	description
coverImages	true, false	whether or not to display cover images for documents
TOC	true, false	whether or not to display the table of contents for the document

or ones that apply to a site as a whole, a second mechanism is available. The interface is defined by a set of XSLT files that transform the page data into HTML. Any of these files can be overridden to provide specialised display, on a site or collection basis.

The first section looks at customizing the existing interface, while the second section looks at defining a whole new interface. The last section describes how to add a new language translation of an interface.

2.6.1 Modifying an existing interface

Most of an interface is defined by XSLT files, which are stored in `$GSDL3HOME/web/interfaces/interface-name/transform`. These can be changed and the changes will take effect straight away. If changes only apply to certain collections or sites, not everything that uses the interface, you can override some of the files by putting new ones in a different place. XSLT files are looked for in the following order: collection, site, interface, default interface. (This currently only applies to sites, and therefore collections, that reside in the same Greenstone installation as the interface.)

Sites and collections can have a transform directory, which is where customised XSLT files should go. Any XSLT files in here will be used in preference to the interface files when using this collection. For example, if you want to have a completely different layout for the about page of a collection, you can put a new `about.xml` file into the collection's `transform` directory, and this will be used instead. This is what we do for the Gutenberg sample collection.

This also applies to files that are included from other XSLT files. For example the `query.xml` for the query pages includes a file called `querytools.xml`. To have a particular site show a different query interface either of these files may need to be modified. Creating a new version of either of these and putting it in the site transform directory will work. Either the new `query.xml` will include the default `querytools`, or the default `query.xml` will include the new `querytools.xml`. The `xsl:include` directives are preprocessed by the java code and full paths added based on availability of the files, so that the correct one is used.

Note that you cannot include a file with the same name as the including file. For example `query.xml` cannot include `query.xml` (it is tempting to want to do this if you just want to change one template for a particular file, and then include the default. but you cant).

2.6.2 Defining a new interface

A new interface may be needed if different instantiations of the library require different interfaces, or different developers want their own look and feel. Creating a new interface will allow modifications to be made while leaving the original one intact.

A new interface needs a directory in `$GSDL3HOME/web/interfaces`, the name of this directory becomes the interface name. Inside, it needs images and transform directories, and an `interfaceConfig.xml` file. Any XSLT may be overridden for a new interface by putting the replacement in the new transform directory. If the appropriate XSLT file is not there, the one from the default interface will be used - this enables just overriding a few XSLT files as needed.

To use a new interface, the Tomcat `web.xml` must be edited: either change the interface that a current servlet instance is using, or add another servlet instantiation to the file (see Section 1.4 or Appendix B). The Tomcat server must be restarted for this to take effect.

2.6.3 Changing the interface language

The interface language can be changed by going to the preferences page, and choosing a language from the list, which includes all languages into which the interface has been translated.

It is easy to add a new interface language to Greenstone . Language specific text strings are separated out from the rest of the system to allow for easy incorporation of new languages. These text strings are contained in Java resource bundle properties files. These are plain text files consisting of key-value pairs, located in `resources/java`. Each interface has one named `interface_name.properties` (where 'name' is the interface name). Each service class has one with the same name as the class (e.g. `GS2Search.properties`). To add another language all of the base `.properties` files must be translated. The translated files keep the same names, but with a language extension added. For example, a French version of `interface_default.properties` would be named `interface_default_fr.properties`.

Keys will be looked up in the properties file closest to the specified language. For example, if language `fr_CA` was specified (French language, country Canada), and the default locale was `en_GB`, Java would look at properties files in the following order, until it found the key: `XXX_fr_CA.properties`, `XXX_fr.properties`, `XXX_en_GB.properties`, then `XXX_en.properties`, and finally the default `XXX.properties`.

These new files are available straight away—to use the new language, add e.g. `l=fr` to the arguments in the URL. To get Greenstone to add it in to the list of languages on the preferences page, an entry needs to be added into the languages list in the `interfaceConfig.xml` file (see Section 1.6.2). Modification of this file requires a restart of the Tomcat server for the changes to be recognised.

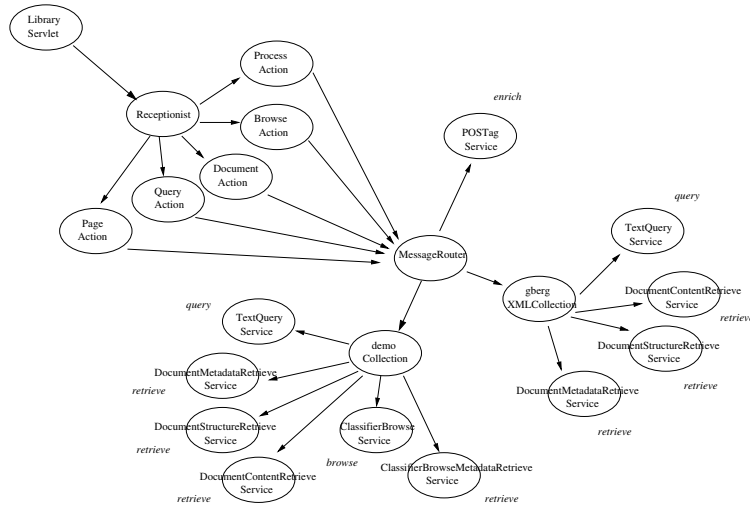


Figure 9: A simple stand-alone site.

3 Developing Greenstone 3: Run-time system

[TODO: rewrite this!!] runtime object structure diagram. describe the modules.
 class hierarchy,
 directory structure and where everything lives
 message format.
 overall description of message passing sequence.
 configuration process - start up and runtime

page generation
 accessing the javadoc

3.1 Overview of modules??

A Greenstone 3 'library' system consists of many components: MessageRouter, Receptionist, Actions, Collections, ServiceRacks etc. Figure 9 shows how they fit together in a stand-alone system. The top left part is concerned with displaying the data, while the bottom right part is the collection data serving part. The two sides communicate through the MessageRouter. There is a one-to-one correspondence between modules and Java classes, with the exception of services: for coding and/or run-time efficiency reasons, several Service modules may be grouped together into one ServiceRack class.

MessageRouter: this is the central module for a site. It controls the site, loading up all the collections, clusters, communicators needed. All messages pass through the MessageRouter. Communication between remote sites is always done between

MessageRouters, one for each site.

Collection and ServiceCluster: these are very similar, and group a set of services into a conceptual group.. They both provide some metadata about the collection/cluster, and a list of services. The services are provided by ServiceRack objects that the collection/cluster loads up. A Collection is a specific type of ServiceCluster. A ServiceCluster groups services that are related conceptually, e.g. all the building services may be part of a cluster. What is part of a cluster is specified by the site configuration file. A Collection's services are grouped by the fact that they all operate on some common data—the documents in the collection. Functionally Collection and ServiceCluster are very similar, but conceptually, and to the user, they are quite different.

Service: these provide the core functionality of the system e.g. searching, retrieving documents, building collections etc. One or more may be grouped into a single Java class (ServiceRack) for code reuse, or to avoid instantiating the same objects several times. For example, MGPP searching services all need to have the index loaded into memory.

Communicator/Server: these facilitate communication between remote modules. For example, if you want MR1 to talk to MR2, you need a Communicator-Server pair. The Server sits on top of MR2, and MR1 talks to the Communicator. Each communication type needs a new pair. So far we have only been using SOAP, so we have a SOAPCommunicator and a SOAPServer.

Receptionist: this is the point of contact for the 'front end'. Its core functionality involves routing requests to the Actions, but it may do more than that. For example, a Receptionist may: modify the request in some way before sending it to the appropriate Action; add some data to the page responses that is common to all pages; transform the response into another form using XSLT. There is a hierarchy of different Receptionist types, which is described in Section 3.9.3.

Actions: these do the job of creating the 'pages'. There is a different action for each type of page, for example PageAction handles semi-static pages, QueryAction handles queries, DocumentAction displays documents. They know a little bit about specific service types. Based on the 'CGI' arguments passed in to them, they construct requests for the system, and put together the responses into data for the page. This data is returned to the Receptionist, which may transform it to HTML. The various actions are described in more detail in Section 3.9.

3.2 Start up configuration

We use the Tomcat web server, which operates either stand-alone in a test mode or in conjunction with the Apache web server. The Greenstone LibraryServlet class is loaded by Tomcat and the servlet's `init()` method is called. Each time a `get/put/post` (etc.) is used, a new thread is started and `doGet()/doPut()/doPost()` (etc.) is called.

The `init()` method creates a new Receptionist and a new MessageRouter. Default classes (DefaultReceptionist, MessageRouter) are used unless subclasses have

been specified in the servlet initiation parameters (see Section 1.4). The appropriate system variables are set for each object (interface name, site name, etc.) and then `configure()` is called on both. The `MessageRouter` handle is passed to the `Receptionist`. The servlet then communicates only with the `Receptionist`, not with the `MessageRouter`.

The `Receptionist` reads in the `interfaceConfig.xml` file (see Section 1.6.2), and loads up all the different `Action` classes. Other `Actions` may be loaded on the fly as needed. `Actions` are added to a map, with shortnames for keys. Eg the `QueryAction` is added with key 'q'. The `Actions` are passed the `MessageRouter` reference too. If the `Receptionist` is a `TransformingReceptionist`, a mapping between shortnames and XSLT file names is also created.

The `MessageRouter` reads in its site configuration file `siteConfig.xml` (see Section 1.6.1). It creates a module map that maps names to objects. This is used for routing the messages. It also keeps small chunks of XML—`serviceList`, `collectionList`, `clusterList` and `siteList`. These are part of what get returned in response to a `describe` request (see Section 3.4.).

Each `ServiceRack` specified in the configuration file is created, then queried for its list of services. Each service name is added to the map, pointing to the `ServiceRack` object. Each service is also added to the `serviceList`. After this stage, `ServiceRacks` are transparent to the system, and each service is treated as a separate module.

`ServiceClusters` are created and passed the `<serviceCluster>` element for configuration. They are added to the map as is, with the cluster name as a key. A `serviceCluster` is also added to the `serviceClusterList`.

For each site specified, the `MessageRouter` creates an appropriate type of `Communicator` object. Then it tries to get the site description. If the server for the remote site is up and running, this should be successful. The site will be added to the mapping with its site name as a key. The site's collections, services and clusters will also be added into the static xml lists. If the server for the remote site is not running, the site will not be included in the `siteList` or module map. To try again to access the site, either Tomcat must be restarted, or a run-time `reconfigure-site` command must be sent (see Section 1.7).

The `MessageRouter` also looks inside the site's `collect` directory, and loads up a `Collection` object for each valid collection found. If a `collectionInit.xml` file is present, a subclass of `Collection` may be used. The `Collection` object reads its `buildConfig.xml` and `collectionConfig.xml` files, determines the metadata, and loads `ServiceRack` classes based on the names specified in `buildConfig.xml`. The `<serviceRack>` XML element is passed to the object to be used in configuration. The `collectionConfig.xml` contents are also passed in to the `ServiceRacks`. Any format or display information that the services need must be extracted from the collection configuration file. `Collection` objects are added to the module map with their name as a key, and also a collection element is added into the `collectionList XML`.

3.3 Message passing

There are two types of messages used by the system: external and internal messages. All messages have an enclosing `<message>` element, which contains either one or more requests, or one or more responses. In the following descriptions, the message element is not shown, but is assumed to be present. Action in Greenstone 3 is originated by a request coming in from the outside. In the standard web-based Greenstone, this comes from a servlet and is passed into the Receptionist. This “external” type request is a request for a page of data, and contains a representation of the CGI style arguments. A page of XML is returned, which can be in HTML format or other depending on the output parameter of the request.

Messages inside the system (“internal” messages) all follow the same basic format: message elements contain multiple request elements, or multiple response elements. Messaging is all synchronous. The same number of responses as requests will be returned. Currently all requests are independent, so any requests can be combined into the same message, and they will be answered separately, with their responses being sent back in a single message.

When a page request (external request) comes in to the Receptionist, it looks at the action attribute and passes the request to the appropriate Action module. The Action will fire one or more internal requests to the MessageRouter, based on the arguments. The data is gathered into a response, which is returned to the Receptionist. The page that the receptionist returns contains the original request, the response from the action and other info as needed (depends on the type of Receptionist). The data may be transformed in some way — for the Greenstone servlet we transform using XSLT to generate html pages.

Actions send internal style messages to the MessageRouter. Some can be answered by it, others are passed on to collections, and maybe on to services. Internal requests are for simple actions, such as search, retrieve metadata, retrieve document text. There are different internal request types: describe, process, system, format, status. Process requests do the actual work of the system, while the other types get auxiliary information. The format of the requests and responses for each internal request type are described in the following sections. External style requests, and their page responses are described in the Section about page generation (Section 3.9).

3.4 ‘describe’-type messages

The most basic of the internal standard requests is “describe-yourself”, which can be sent to any module in the system. The module responds with a semi-predefined piece of XML, making these requests very efficient. The response is predefined apart from any language-specific text strings, which are put together as each request comes in, based on the language attribute of the request.

```
<request lang='en' type='describe' to=''/>
```

If the `to` field is empty, a request is answered by the `MessageRouter`. An example response from a `MessageRouter` might look like this:

```
<response lang='en' type='describe'>
  <serviceList/>
  <siteList>
    <site name='org.greenstone.gsd11'
          address='http://localhost:8080/soap/servlet/rpcrouter'
          type='soap' />
  </siteList>
  <serviceClusterList>
    <serviceCluster name="build" />
  </serviceClusterList>
  <collectionList>
    <collection name='org.greenstone.gsd11/
                  org.greenstone.gsd12/fao' />
    <collection name='org.greenstone.gsd11/demo' />
    <collection name='org.greenstone.gsd11/fao' />
    <collection name='myfiles' />
  </collectionList>
</response>
```

This `MessageRouter` has no individual site-wide services (an empty `<serviceList>`), but has a service cluster called `build` (which provides collection importing and building functionality). It communicates with one site, `org.greenstone.gsd11`. It is aware of four collections. One of these, `myfiles`, belongs to it; the other three are available through the external site. One of those collections is actually from a further external site.

It is possible to ask just for a specific part of the information provided by a `describe` request, rather than the whole thing. For example, these two messages get the `collectionList` and the `siteList` respectively:

```
<request lang='en' type='describe' to=''>
  <paramList>
    <param name='subset' value='collectionList' />
  </paramList>
</request>

<request lang='en' type='describe' to=''>
  <paramList>
    <param name='subset' value='siteList' />
  </paramList>
</request>
```

Subset options for the `MessageRouter` include `collectionList`, `serviceClusterList`, `serviceList`, `siteList`.

When a collection or service cluster is asked to describe itself, what is returned is a list of metadata, some display elements, and a list of services. For example, here is such a message, along with a sample response.

```
<request lang='en' type='describe' to='mgppdemo' />
```

```

<response from="mgppdemo" type="describe">
  <collection name="mgppdemo">
    <displayItem lang="en" name="name">greenstone mgpp demo
    </displayItem>
    <displayItem lang="en" name="description">This is a
      demonstration collection for the Greenstone digital
      library software. It contains a small subset (11 books)
      of the Humanity Development Library. It is built with
      mgpp.</displayItem>
    <displayItem lang="en" name="icon">mgppdemo.gif</displayItem>
    <serviceList>
      <service name="DocumentStructureRetrieve" type="retrieve" />
      <service name="DocumentMetadataRetrieve" type="retrieve" />
      <service name="DocumentContentRetrieve" type="retrieve" />
      <service name="ClassifierBrowse" type="browse" />
      <service name="ClassifierBrowseMetadataRetrieve"
        type="retrieve" />
      <service name="TextQuery" type="query" />
      <service name="FieldQuery" type="query" />
      <service name="AdvancedFieldQuery" type="query" />
      <service name="PhindApplet" type="applet" />
    </serviceList>
    <metadataList>
      <metadata name="creator">greenstone@cs.waikato.ac.nz</metadata>
      <metadata name="numDocs">11</metadata>
      <metadata name="buildType">mgpp</metadata>
      <metadata name="httpPath">http://kanuka:8090/gsd13/sites/
        localsite/collect/mgppdemo</metadata>
    </metadataList>
  </collection>
</response>

```

Subset options for a collection or serviceCluster include `metadataList`, `serviceList`, and `displayItemList`.

This collection provides many typical services. Notice how this response lists the services available, while the collection configuration file for this collection (Figure 5) described serviceRacks. Once the service racks have been configured, they become transparent in the system, and only services are referred to. There are three document retrieval services, for structural information, metadata, and content. The Classifier services retrieve classification structure and metadata. These five services were all provided by the GS2MGPPRetrieve ServiceRack. The three query services were provided by GS2MGPPSearch serviceRack, and provide different kinds of query interface. The last service, PhindApplet, is provided by the PhindPhraseBrowse serviceRack and is an applet service.

A `describe` request sent to a service returns a list of parameters that the service accepts and some display information, (and in future may describe the content type for the request and response). Subset options for the request include `paramList` and `displayItemList`.

Parameters can be in the following formats:

```

<param name='xxx' type='integer|boolean|string|invisible' default='yyy' />
<param name='xxx' type='enum_single|enum_multi' default='aa' />
  <option name='aa' /><option name='bb' />...
</param>
<param name='xxx' type='multi' occurs='4'>
  <param ... />
  <param ... />
</param>

```

If no default is specified, the parameter is assumed to be mandatory. Here are some examples of parameters:

```

<param name='case' type='boolean' default='0' />

<param name='maxDocs' type='integer' default='50' />

<param name='index' type='enum' default='dtx'>
  <option name='dtx' />
  <option name='stt' />
  <option name='stx' />
</param>

<!-- this one is for the text box and field list for the
simple field query-->
<param name='simpleField' type='multi' occurs='4'>
  <param name='fqv' type='string' />
  <param name='fqf' type='enum_single'>
    <option name='TI' /><option name='AU' /><option name='OR' />
  </param>
</param>

```

The type attribute is used to determine how to display the parameters on a web page or interface. For example, a string parameter may result in a text entry box, a boolean an on/off button, enum_single/enum_multi a drop-down menu, where one or many items, respectively, can be selected. A multi-type parameter indicates that two or more parameters are associated, and should be displayed appropriately. For example, in a field query, the text box and field list should be associated. The occurs attribute specifies how many times the parameter should be displayed on the page. Parameters also come with display information: all the text strings needed to present them to the user. These include the name of the parameter and the display values for any options. These are included in the above parameter descriptions in the form of <displayItem> elements.

A service description also contains some display information—this includes the name of the service, and the text for the submit button.

Here is a sample describe request to the FieldQuery service of collection mgppdemo, along with its response. The parameters in this example include their display information. Figure 10 shows an example html search form that may be generated from this describe response.

```

<request lang="en" to="mgppdemo/FieldQuery" type="describe" />

```

```

<response from="mgppdemo/FieldQuery" type="describe">
  <service name="FieldQuery" type="query">
    <displayItem name="name">Form Query</displayItem>
    <displayItem name="submit">Search</displayItem>
    <paramList>
      <param default="Doc" name="level" type="enum_single">
        <displayItem name="name">Granularity to search at</displayItem>
        <option name="Doc">
          <displayItem name="name">Document</displayItem>
        </option>
        <option name="Sec">
          <displayItem name="name">Section</displayItem>
        </option>
        <option name="Para">
          <displayItem name="name">Paragraph</displayItem>
        </option>
      </param>
      <param default="1" name="case" type="boolean">
        <displayItem name="name">Turn casefolding </displayItem>
        <option name="0">
          <displayItem name="name">off</displayItem>
        </option>
        <option name="1">
          <displayItem name="name">on</displayItem>
        </option>
      </param>
      <param default="1" name="stem" type="boolean">
        <displayItem name="name">Turn stemming </displayItem>
        <option name="0">
          <displayItem name="name">off</displayItem>
        </option>
        <option name="1">
          <displayItem name="name">on</displayItem>
        </option>
      </param>
      <param default="10" name="maxDocs" type="integer">
        <displayItem name="name">Maximum documents to return
        </displayItem>
      </param>
      <param name="simpleField" occurs="4" type="multi">
        <displayItem name="name"></displayItem>
        <param name="fqv" type="string">
          <displayItem name="name">Word or phrase </displayItem>
        </param>
        <param default="ZZ" name="fqf" type="enum_single">
          <displayItem name="name">in field</displayItem>
          <option name="ZZ">
            <displayItem name="name">allfields</displayItem>
          </option>
          <option name="TX">
            <displayItem name="name">text</displayItem>
          </option>
          <option name="TI">

```

Figure 10: The previous query service describe response as displayed on the search page.

```

        <displayItem name="name">Title</displayItem>
    </option>
    <option name="SU">
        <displayItem name="name">Subject</displayItem>
    </option>
    <option name="ORG">
        <displayItem name="name">Organization</displayItem>
    </option>
    <option name="SO">
        <displayItem name="name">Source</displayItem>
    </option>
</param>
</param>
</paramList>
</service>
</response>

```

A describe request to an applet type service returns the applet html element: this will be embedded into a web page to run the applet.

```

<request type='describe' to='mgppdemo/PhindApplet' />

<response type='describe'>
  <service name='PhindApplet' type='query'>
    <applet ARCHIVE='phind.jar, xercesImpl.jar, gsd13.jar,
jaxp.jar, xml-apis.jar'
      CODE='org.greenstone.applet.phind.Phind.class'
      CODEBASE='lib/java'
      HEIGHT='400' WIDTH='500'>
    <PARAM NAME='library' VALUE='' />
    <PARAM NAME='phindcgi' VALUE='?a=a&sa=r&sn=Phind' />

```

```

    <PARAM NAME='collection' VALUE='mgppdemo' />
    <PARAM NAME='classifier' VALUE='1' />
    <PARAM NAME='orientation' VALUE='vertical' />
    <PARAM NAME='depth' VALUE='2' />
    <PARAM NAME='resultorder' VALUE='L,l,E,e,D,d' />
    <PARAM NAME='backdrop' VALUE='interfaces/default/
    images/phindbg1.jpg' />
    <PARAM NAME='fontsize' VALUE='10' />
    <PARAM NAME='blocksize' VALUE='10' />
    The Phind java applet.
  </applet>
  <displayItem name="name">Browse phrase hierarchies</displayItem>
</service>
</response>

```

Note that the library parameter has been left blank. This is because library refers to the current servlet that is running and the name is not necessarily known in advance. So either the applet action or the Receptionist must fill in this parameter before displaying the html.

3.5 'system'-type messages

“System” requests are used to tell a MessageRouter, Collection or ServiceCluster to update its cached information and activate or deactivate other modules. For example, the MessageRouter has a set of Collection modules that it can talk to. It also holds some XML information about those collections—this is returned when a request for a collection list comes in. If a collection is deleted or modified, or a new one created, this information may need to change, and the list of available modules may also change. Currently these requests are initiated by particular CGI requests (see Section 1.7).

The basic format of a system request is as follows:

```

<request type='system' to=''>
  <system .../>
</request>

```

One or more actual requests are specified in system elements. The following are examples:

```

<system type='configure' subset='' />
<system type='configure' subset='collectionList' />
<system type='activate' moduleType='collection' moduleName='demo' />
<system type='deactivate' moduleType='site' moduleName='site1' />

```

The first request reconfigures the whole site—the MessageRouter goes through its whole configure process again. The second request just reconfigures the collectionList—the MessageRouter will delete all its collection information, and re-look through the collect directory and reload all the collections again. The third request is to activate collection demo. This could be a new collection, or a reactivation of an old

one. If a collection module already exists, it will be deleted, and a new one loaded. The final request deactivates the site `site1`—this removes the site from the `siteList` and module map, and also removes any of that sites collections/services from the static lists.

A response just contains a status message⁸, for example:

```
<status>MessageRouter reconfigured successfully</status>
<status>Error on reconfiguring collectionList</status>
<status>collection:demo activated</status>
<status>site:site1 deactivated</status>
```

System requests are mainly answered by the `MessageRouter`. However, `Collections` and `ServiceClusters` will respond to a subset of these requests.

3.6 'format'-type messages

Collection designers are able to specify how their collection looks to a certain degree. They can specify format statements for display that will apply to the results of a search, the display of a document, entries in a classification hierarchy, for example. This info is generally service specific. All services respond to a format request, where they return any service specific formatting information. A typical request and response looks like this:

```
<request lang="en" to="mgppdemo/FieldQuery" type="format" />

<response from="mgppdemo/FieldQuery" type="format">
  <format>
    <gsf:template match="documentNode"><td><gsf:link>
      <gsf:metadata name="Title" /><gsf:metadata name="Source" />
    </gsf:link></td>
    </gsf:template>
  </format>
</response>
```

The actual format statements are described in Section 2.5. They are templates written directly in XSLT, or in GSF (GreenStone Format) which is a simple XML representation of the more complicated XSLT templates. GSF-style format statements need to be converted to proper XSLT. This is currently done by the `Receptionist` (but may be moved to an `ActionHelper`): the format XML is transformed to XSLT using XSLT with the `config.format.xml` stylesheet.

3.7 'status'-type messages

These are only used with process-type services, which are those where a request is sent to start some type of process (see Section 3.8.4). An initial 'process' request to a 'process' service generates a response which states whether the process had successfully started, and whether its still continuing. If the process is not finished,

⁸TODO: add in error/status codes

Table 7: Status codes currently used in Greenstone 3

code name	code value	meaning
SUCCESS	1	the request was accepted, and the process was completed
ACCEPTED	2	the request was accepted, and the process has been started, but it is not completed yet
ERROR	3	there was an error and the process was stopped
CONTINUING	10	the process is still continuing
COMPLETED	11	the process has finished
HALTED	12	the process has stopped
INFO	20	just an info message that doesn't imply anything

status requests can be sent repeatedly to the service to poll the status, using the pid to identify the process. Status codes are used to identify the state of a process. The values used at the moment are listed in Table 7⁹.

The following shows an example status request, along with two responses, the first a 'OK but continuing' response, and the second a 'successfully completed' response. The content of the status elements in the two responses is the output from the process since the last status update was sent back.

```
<request lang="en" to="build/ImportCollection" type="status">
  <paramList>
    <param name="pid" value="2" />
  </paramList>
</request>

<response from="build/ImportCollection">
  <status code="2" pid="2">Collection construction: import collection.
command = import.pl -collectdir /research/kjdon/home/gsd13/web/sites/
  localsite/collect test1
starting
  </status>
</response>

<response from="build/ImportCollection">
  <status code="11" pid="2">RecPlug: getting directory
/research/kjdon/home/gsd13/web/sites/localsite/collect/test1/import
WARNING - no plugin could process /.keepme

*****
Import Complete
*****
* 1 document was considered for processing
* 0 were processed and included in the collection
* 1 was rejected. See /research/kjdon/home/gsd13/web/sites/
  localsite/collect/test1/etc/fail.log for a list of rejected documents
Success
  </status>
</response>
```

⁹A more standard set of codes should probably be used, for example, the HTTP codes

3.8 'process'-type messages

Process requests and responses provide the major functionality of the system—these are the ones that do the actual work. The format depends on the service they are for, so I'll describe these by service.

Query type services TextQuery, FieldQuery, AdvancedFieldQuery (GS2MGSearch, GS2MGPPSearch), TextQuery (LuceneSearch) The main type of requests in the system are for services. There are different types of services, currently: `query`, `browse`, `retrieve`, `process`, `applet`, `enrich`. Query services do some kind of search and return a list of document identifiers. Retrieve services can return the content of those documents, metadata about the documents, or other resources. Browse is for browsing lists or hierarchies of documents. Process type services are those where the request is for a command to be run. A status code will be returned immediately, and then if the command has not finished, an update of the status can be requested. Applet services are those that run an applet. Enrich services take a document and return the document with some extra markup added.

Other possibilities include transform, extract, accrete. These types of service generally enhance the functionality of the first set. They may be used during collection formation: 'accrete' documents by adding them to a collection, 'transform' the documents into a different format, 'extract' information or acronyms from the documents, 'enrich' those documents with the information extracted or by adding new information. They may also be used during querying: 'transform' a query before using it to query a collection, or 'transform' the documents you get back into an appropriate form.

The basic structure of a service 'process' request is as follows:

```
<request lang='en' type='process' to='demo/TextQuery'>
  <paramList/>
  other elements...
</request>
```

The parameters are name-value pairs corresponding to parameters that were specified in the service description sent in response to a describe request.

```
<param name='case' value='1' />
<param name='maxDocs' value='34' />
<param name='index' value='dtx' />
```

Some requests have other content—for document retrieval, this would be a list of document identifiers to retrieve. For metadata retrieval, the content is the list of documents to retrieve metadata for.

Responses vary depending on the type of request. The following sections look at the process type requests and responses for each type of service.

3.8.1 'query'-type services

Responses to query requests contain a list of document identifiers, along with some other information, dependent on the query type. For a text query, this includes term frequency information, and some metadata about the result. For instance, a text query on 'snail farming', with the parameter 'maxDocs=10' might return the first 10 documents, and one of the query metadata items would be the total number of documents that matched the query.¹⁰

The following shows an example query request and its response.

Find at most 10 Sections in the mgppdemo collection, containing the word snail (stemmed), returning the results in ranked order:

```
<request lang='en' to="mgppdemo/TextQuery" type="process">
  <paramList>
    <param name="maxDocs" value="10"/>
    <param name="queryLevel" value="Section"/>
    <param name="stem" value="1"/>
    <param name="matchMode" value="some"/>
    <param name="sortBy" value="1"/>
    <param name="index" value="t0"/>
    <param name="case" value="0"/>
    <param name="query" value="snail"/>
  </paramList>
</request>

<response from="mgppdemo/TextQuery" type="process">
  <metadataList>
    <metadata name="numDocsMatched" value="59" />
  </metadataList>
  <documentNodeList>
    <documentNode nodeID="HASHac0a04dd14571c60d7fbfd.4.2"
docType='hierarchy' nodeType="leaf" />
    <documentNode nodeID="HASH010f073f22033181e206d3b7.2.12"
docType='hierarchy' nodeType="leaf" />
    <documentNode nodeID="HASH010f073f22033181e206d3b7.1"
docType='hierarchy' nodeType="interior" />
    <documentNode nodeID="HASHac0a04dd14571c60d7fbfd.2.2"
docType='hierarchy' nodeType="leaf" />
    ...
  </documentNodeList>
  <termList>
    <term field="" freq="454" name="snail" numDocsMatch="58" stem="3">
      <equivTermList>
        <term freq="" name="Snail" numDocsMatch="" />
        <term freq="" name="snail" numDocsMatch="" />
        <term freq="" name="Snails" numDocsMatch="" />
        <term freq="" name="snails" numDocsMatch="" />
      </equivTermList>
    </term>
  </termList>
</response>
```

¹⁰no metadata about the query result is returned yet.

The list of document identifiers includes some information about document type and node type. Currently, document types include `simple`, `paged` and `hierarchy`. `simple` is for single section documents, i.e. ones with no sub-structure. `paged` is documents that have a single list of sections, while `hierarchy` type documents have a hierarchy of nested sections. For `paged` and `hierarchy` type documents, the node type identifies whether a section is the root of the document, an internal section, or a leaf.

The term list identifies, for each term in the query, what its frequency in the collection is, how many documents contained that term, and a list of its equivalent terms (if stemming or casefolding was used).

3.8.2 'browse'-type services

Browse type services are used for classification browsing. The request consists of a list of classifier identifiers, and some structure parameters listing what structure to retrieve.

```
<request lang="en" to="mgppdemo/ClassifierBrowse" type="process">
  <paramList>
    <param name="structure" value="ancestors" />
    <param name="structure" value="children" />
  </paramList>
  <classifierNodeList>
    <classifierNode nodeID="CL1.2" />
  </classifierNodeList>
</request>

<response from="mgppdemo/ClassifierBrowse" type="process">
  <classifierNodeList>
    <classifierNode nodeID="CL1">
      <nodeStructure>
        <classifierNode nodeID="CL1">
          <classifierNode nodeID="CL1.2">
            <classifierNode nodeID="CL1.2.1" />
            <classifierNode nodeID="CL1.2.2" />
            <classifierNode nodeID="CL1.2.3" />
            <classifierNode nodeID="CL1.2.4" />
            <classifierNode nodeID="CL1.2.5" />
          </classifierNode>
        </classifierNode>
      </nodeStructure>
    </classifierNode>
  </classifierNodeList>
</response>
```

Possible values for structure parameters are `ancestors`, `parent`, `siblings`, `children`, `descendents`. The response gives, for each identifier in the request, a `<nodeStructure>` element with all the requested structure put together into a hierarchy. The structure may include classifier and document nodes.

3.8.3 'retrieve'-type services

Retrieval services are special in that requests are not explicitly initiated by a user from a form on a web page, but are called from actions in response to other things. This means that their names are hard-coded into the Actions. `DocumentContentRetrieve`, `DocumentStructureRetrieve` and `DocumentMetadataRetrieve` are the standard names for retrieval services for content, structure, and metadata of documents. Requests to each of these include a list of document identifiers. Because these generally refer to parts of documents, the elements are called `<documentNode>`. For the content, that is all that is required. For the metadata retrieval service, the request also needs parameters specifying what metadata is required. For structure retrieval services, requests need parameters specifying what structure or structural info is required.

Some example requests and responses follow.

Give me the Title metadata for these documents:

```
<request lang="en" to="mgppdemo/DocumentMetadataRetrieve" type="process">
  <paramList>
    <param name="metadata" value="Title" />
  </paramList>
  <documentNodeList>
    <documentNode nodeID="HASHac0a04dd14571c60d7fbfd.4.2"/>
    <documentNode nodeID="HASH010f073f22033181e206d3b7.2.12"/>
    <documentNode nodeID="HASH010f073f22033181e206d3b7.1"/>
    ...
  </documentNodeList>
</request>

<response from="mgppdemo/DocumentMetadataRetrieve" type="process">
  <documentNodeList>
    <documentNode nodeID="HASHac0a04dd14571c60d7fbfd.4.2">
      <metadataList>
        <metadata name="Title">Putting snails in your second pen</metadata>
      </metadataList>
    </documentNode>
    <documentNode nodeID="HASH010f073f22033181e206d3b7.2.12">
      <metadataList>
        <metadata name="Title">Now you must decide</metadata>
      </metadataList>
    </documentNode>
    <documentNode nodeID="HASH010f073f22033181e206d3b7.1">
      <metadataList>
        <metadata name="Title">Introduction</metadata>
      </metadataList>
    </documentNode>
  </documentNodeList>
</response>
```

One or more parameters specifying metadata may be included in a request. Also, a value of `all` will retrieve all the metadata for each document.

Any browse-type service must also implement a metadata retrieval service to provide metadata for the nodes in the classification hierarchy. The name of it is the browse service name plus `MetadataRetrieve`. For example, the `ClassifierBrowse` service described in the previous section should also have a `ClassifierBrowseMetadataRetrieve` service. The request and response format is exactly the same as for the `DocumentMetadataRetrieve` service, except that `<documentNode>` elements are replaced by `<classifierNode>` elements (and the corresponding list element is also changed).

Give me the text (content) of this document:

```
<request lang="en" to="mgppdemo/DocumentContentRetrieve" type="process">
  <paramList />
  <documentNodeList>
    <documentNode nodeID="HASHac0a04dd14571c60d7fbfd.4.2" />
  </documentNodeList>
</request>

<response from="mgppdemo/DocumentContentRetrieve" type="process">
  <documentNodeList>
    <documentNode nodeID="HASHac0a04dd14571c60d7fbfd.4.2">
      <nodeContent>&lt;Section&gt;
        &lt;/B&gt;&lt;P ALIGN="&quot;JUSTIFY&quot;&gt;&gt;&lt;/P&gt;
        &lt;P ALIGN="&quot;JUSTIFY&quot;&gt;&gt;190. When the plants in
        your second pen have grown big enough to provide food and
        shelter, you can put in the snails.&lt;/P&gt;
      </nodeContent>
    </documentNode>
  </documentNodeList>
</response>
```

The content of a node is returned in a `<nodeContent>` element. In this case it is escaped HTML.

Give me the ancestors and children of the specified node, along with the number of siblings it has:

```
<request lang="en" to="mgppdemo/DocumentStructureRetrieve" type="process">
  <paramList>
    <param name="structure" value="ancestors" />
    <param name="structure" value="children" />
    <param name="info" value="numSiblings" />
  </paramList>
  <documentNodeList>
    <documentNode nodeID="HASHac0a04dd14571c60d7fbfd.4.2" />
  </documentNodeList>
</request>

<response from="mgppdemo/DocumentStructureRetrieve" type="process">
  <documentNodeList>
    <documentNode nodeID="HASHac0a04dd14571c60d7fbfd.4.2">
      <nodeStructureInfo>
        <info name="numSiblings" value="2" />
      </nodeStructureInfo>
    </documentNode>
  </documentNodeList>
</response>
```

```

<nodeStructure>
  <documentNode nodeID="HASHac0a04dd14571c60d7fbfd"
    docType='hierarchy' nodeType="root">
    <documentNode nodeID="HASHac0a04dd14571c60d7fbfd.4"
      docType='hierarchy' nodeType="interior">
      <documentNode nodeID="HASHac0a04dd14571c60d7fbfd.4.2"
        docType='hierarchy' nodeType="leaf" />
      </documentNode>
    </documentNode>
  </documentNode>
</nodeStructure>
</documentNode>
</documentNodeList>
</response>

```

Structure is returned inside a `<nodeStructure>` element, while structural info is returned in a `<nodeStructureInfo>` element. Possible values for structure parameters are as for browse services: `ancestors`, `parent`, `siblings`, `children`, `descendents`. Possible values for info parameters are `numSiblings`, `siblingPosition`, `numChildren`.

3.8.4 'process'-type services

Requests to process-type services are not requests for data—they request some action to be carried out, for example, create a new collection, or import a collection. The response is a status or an error message. The import and build commands may take a long time to complete, so a response is sent back after a successful start to the command. The status may be polled by the requester to see how the process is going.

Process requests generally contain just a parameter list. Like for any service, the parameters used by a process-type service can be obtained by a describe request to that service.

Here are two example requests for process-services that are part of the build service cluster (hence the addresses all begin with 'build/'), followed by an example response:

```

<request lang='en' type='process' to='build/NewCollection'>
  <paramList>
    <param name='creator' value='me@home.com' />
    <param name='collName' value='the demo collection' />
    <param name='collShortName' value='demo' />
  </paramlist>
</request>

<request lang='en' type='process' to='build/ImportCollection'>
  <paramList>
    <param name='collection' value='demo' />
  </paramlist>
</request>

<response from="build/ImportCollection">

```



```

    <status code="2" pid="2">Starting process...</status>
</response>

```

The `code` attribute in the response specifies whether the command has been successfully stated, whether its still going, etc (see Table 7 for a list of currently used codes). The `pid` attribute specifies a process id number that can be used when querying the status of this process. The content of the status element is (currently) just the output from the process so far. Status messages, which were described in Section 3.7, are used to find out how the process is going, and whether it has finished or not.

3.8.5 'applet'-type services

Applet-type services are those that process the data for an applet. A request consists only of a list of parameters, and the response contains an `<appletData>` element that contains the XML data to be returned to the applet. The format of this is entirely specific to the applet—there is no set format to the applet data.

Here is an example request and response, used by the Phind applet:

```

<request type='query' to='mgppdemo/PhindApplet'>
  <paramList>
    <param name='pc' value='1' />
    <param name='pptext' value='health' />
    <param name='pfe' value='0' />
    <param name='ple' value='10' />
    <param name='pfd' value='0' />
    <param name='pld' value='10' />
    <param name='pfl' value='0' />
    <param name='pll' value='10' />
  </paramList>
</request>

<response type='query' from='mgppdemo/PhindApplet'>
  <appletData>
    <phindData df='9' ef='46' id='933' lf='15' tf='296'>
      <expansionList end='10' length='46' start='0'>
        <expansion df='4' id='8880' num='0' tf='59'>
          <suffix> CARE</suffix>
        </expansion>
        ...
      </expansionList>
    <documentList end='10' length='9' start='0'>
      <document freq='78' hash='HASH4632a8a51d33c47a75c559' num='0'>
        <title>The Courier - N??159 - Sept- Oct 1996 Dossier Investing
          in People Country Reports: Mali ; Western Samoa
        </title>
      </document>
      ...
    </documentList>
    <thesaurusList end='10' length='15' start='0'>
      <thesaurus df='7' id='12387' tf='15' type='RT'>

```

```

        <phrase>PUBLIC HEALTH</phrase>
    </thesaurus>...
</thesaurusList>
</phindData>
</appletData>
</response>

```

3.8.6 'enrich'-type services

Enrich services typically take some text of documents (inside `<nodeContent>` tags) and returns the text marked up in some way. One example of this is the GatePOSTag service: this identifies Dates, Locations, People and Organizations in the text, and annotates the text with the labels. In the following example, the request is for Location and Dates to be identified.

```

<request lang="en" to="GatePOSTag" type="process">
  <paramList>
    <param name="annotationType" value="Date,Location" />
  </paramList>
  <documentNodeList>
    <documentNode nodeID="HASHac0a04dd14571c60d7fbfd">
      <nodeContent>
        FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
        Rome 1986
        P-69
        ISBN 92-5-102397-2
        FAO 1986
      </nodeContent>
    </documentNode>
  </documentNodeList>
</request>

<response from="GatePOSTag" type="process">
  <documentNodeList>
    <documentNode nodeID="HASHac0a04dd14571c60d7fbfd">
      <nodeContent>
        FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
        <annotation type="Location">Rome</annotation>
        <annotation type="Date">1986</annotation>
        P-69
        ISBN 92-5-102397-2
        FAO <annotation type="Date">1986</annotation>
      </nodeContent>
    </documentNode>
  </documentNodeList>
</response>

```

3.9 Page generation

A 'page' is some XML or HTML (or other?) data returned in response to an external 'page'-type request. These requests originate from outside Greenstone , for

example from a servlet, or java application, and are received by the Receptionist. As described below in Section 3.9.1, the requests are XML representations of Greenstone URLs. One of the arguments is action (a). This tells the Receptionist which Action module to pass the request to.

Action modules decode the rest of the arguments to determine what requests need to be made to the system. One or more internal requests may be made to the MessageRouter. A request for format information from the Collection/Service may also be made. The resulting data is gathered together into a single XML response, <page>, and returned to the Receptionist.

The page format is described in Section 3.9.2. The XML may be returned as is, or may be modified by the Receptionist. The various Receptionists are described in Section 3.9.3. The default receptionist used by a servlet transforms the XML into HTML using XSL stylesheets. Section 3.9.4 looks at collection specific formatting, in particular for HTML output. Sections 3.9.6 to 3.9.12 look at the various actions and what kind of data they gather.

3.9.1 'page'-type requests and their arguments

These are requests for a 'page' of data—for example, the home page for a site; the query page for a collection; the text of a document. They contain, in XML, a list of arguments specifying what type of page is required. If the external context is a servlet, the arguments represent the 'CGI' arguments in a Greenstone URL. The two main arguments are a (action) and sa (subaction). All other arguments are encoded as parameters.

Here are some examples of requests¹¹:

```
<request type='page' action='p' subaction='about'
        lang='fr' output='html'>
  <paramList>
    <param name='c' value='demo' />
  </paramList>
</request>

<request type='page' action='q' lang='en' output='html'>
  <paramList>
    <param name='s' value='TextQuery' />
    <param name='c' value='demo' />
    <param name='rt' value='r' />
    <!-- the rest are the service specific params -->
    <param name='ca' value='0' /> <!-- casefold -->
    <param name='st' value='1' /> <!-- stem -->
    <param name='m' value='10' /> <!-- maxdocs -->
    <param name='q' value='snail' /> <!-- query string -->
  </paramList>
</request>
```

¹¹In a servlet context, these correspond to the arguments a=p&sa=about&c=demo&l=fr, and a=q&l=en&s=TextQuery&c=demo&rt=r&ca=0&st=1&m=10&q=snail.

Argument	Meaning	Typical values
a	action	a (applet), q (query), b (browse), p (page), pr (process) s (system)
sa	subaction	home, about (page action)
c	collection or service cluster	demo, build
s	service name	TextQuery, ImportCollection
rt	request type	d (display), r (request), s (status)
ro	response only	0 or 1 - if set to one, the request is carried out but no processing of the results is done currently only used in process actions
o	output type	XML, html, WML
l	language	en, fr, zh ...
d	document id	HASHxxx
r	resource id	???
pid	process handle	an integer identifying a particular process request

Table 8: Generic arguments that can appear in a Greenstone URL

There are some standard arguments used in Greenstone, and they are described in Table 8. These are used by Receptionists and Actions. The `GSPParams` class specifies all the general basic arguments, and whether they should be saved or not (Some arguments need to be saved during a session, and this needs to be implemented outside Greenstone proper — currently we do this in the servlet, using servlet session handling). The servlet has an init parameter `params_class` which specifies which params class to use: `GSPParams` can be subclassed if necessary. The Receptionist and Actions must not have conflicting argument names.

Other arguments are used dynamically and come from the Services. Service arguments must always be saved during a session. Services may be created by different people, and may reside on a different site. There is no guarantee that there is no conflict with argument names between services and actions. Therefore service parameters are namespaced when they are put on the page, whereas interface (receptionist and action) parameters have no namespace. The default namespace is `s1` (service1) — any parameters that are for the service will be prefixed by this. For example, the case parameter for a search will be put in the page as `s1.case`, and the resulting argument in a search URL will be `s1.case`. When actions are deciding which parameters need to be sent in a request to a service, they can use the namespace information.

If there are two or more services combined on a page with a single submit button, they will use namespaces `s1`, `s2`, `s3` etc as needed. The `s` (service) parameter will end up with a list of services. For example, `s=TextQuery,MusicQuery`, and the order of these determines the mapping order of the namespaces, i.e. `s1` will map to `TextQuery`, `s2` to `MusicQuery`.

3.9.2 page format

The basic page format is:

```
<page lang='en'>
  <pageRequest/>
  <pageResponse/>
</page>
```

* show configuration and describe what's used for

There are two main elements in the page: `pageRequest`, `pageResponse`. The `pageRequest` is the original request that came into the Receptionist—this is included so that any parameters can be preset to their previous values, for example, the query options on the query form. The `pageResponse` contains all the data that has been gathered from the system by the action. The other two elements contain extra information needed by XSLT. `Config` contains run-time variables such as the location of the `gsdl` home directory, the current site name, the name of the executable that is running (e.g. `library`)—these are needed to allow the XSLT to generate correct HTML URLs. `Display` contains some of the text strings needed in the interface—these are separate from the XSLT to allow for internationalization.

The following subsections outline, for each action, what data is needed and what requests are generated to send to the system.

Once the XML page has been put together, the page to return to the user is created by transforming the XML using XSLT. The output is HTML at this stage, but it will be possible to generate alternative outputs, such as XML, WML etc. A set of XSLT files defines an 'interface'. Different users can change the look of their web pages by creating new XSLT files for a new 'interface'. Just as we have a sites directory where different sites 'live' (ie where their configuration file and collections are located), we have an interfaces directory where the different interfaces 'live' (ie their transforms and images are located there). The default XSLT files are located in `interfaces/default/transforms`. Collections, sites and other interfaces can override these files by having their own copy of the appropriate files. New interfaces have their own directory inside `interfaces/`. Sites and collections can have a transform directory containing XSLT files. The order in which the XSLT files are looked for is collection, site, current interface, default interface.¹²

TODO describe a bit more?? currently only can get this locally

3.9.3 Receptionists

The receptionist is the controlling module for the page generation part of Greenstone. It has the job of loading up all the actions, and it knows about the message router it and the actions are supposed to talk to. It routes messages received to the appropriate action (page-type messages) or directly to the message router (all other types). Receptionists also do other things, for example, adding to the page received back from the action any information that is common to all pages.

There are different ways of providing an interface to Greenstone, from web based CGI style (using servlets) to Java GUI applications. These different inter-

¹²this currently breaks down for remote sites - need to rethink it a bit.

faces require slightly different responses from a receptionist, so we provide several standard types of receptionist.

Receptionist: This is the most basic receptionist. The page it returns consists of the original request, and the response from the action it was sent to. Methods `preProcessRequest`, and `postProcessPage` are called on the request and page, respectively, but in this basic receptionist, they don't do anything.

TransformingReceptionist: This extends `Receptionist`, and overwrites `postProcessPage` to transform the page using XSLT. An XSLT is listed for each action in the receptionists configuration file, and this is used to transform the page. First, some display information, and configuration information is added to the page. Then it is transformed using the specified XSLT for the action, and returned.

WebReceptionist: The `WebReceptionist` extends `TransformingReceptionist`. It doesn't do much else except some argument conversion. To keep the URLs short, parameters from the services are given shortnames, and these are used in the web pages.

DefaultReceptionist: This extends `WebReceptionist`, and is the default one for Greenstone 3 servlets. Due to the page design, some extra information is needed for each page: some metadata about the current collection. The receptionist sends a describe request to the collection to get this, and appends it to the page before transformation using XSLT.

NZDLReceptionist: (do we want to talk about this?) This is an example of a custom receptionist. For a look-alike `nzdl.org` system, even more information is needed for each page, namely the list of classifiers available from the Classifier-Browse service.

By default, the `LibraryServlet` uses `DefaultReceptionist`. However, there is a servlet init-param called `receptionist` which can be set to make the servlet use a different one.

3.9.4 Collection specific formatting

get format info, transform `gsf-ζxsl`. transform `xml-ζhtml`
config params are passed in to the transformation

3.9.5 CGI arguments

3.9.6 Page action

`PageAction` is responsible for displaying kinds of information pages, such as the home page of the library, or the home page of a collection, or the help and preferences pages. These pages are not associated with specific services like the other page types. In general, the data comes from describe requests to various modules. The different pages are requested using the subaction argument. For the 'home' page, a 'describe' request is sent to the `MessageRouter`—this returns a list of all the collections, services, `serviceClusters` and sites known about. For each collection, its metadata is retrieved via a 'describe' request. This metadata is added into

the previous result, which is then added into the page. For the 'about' page, a `describe` request is sent to the module that the about page is about: this may be a collection or a service cluster. This returns a list of metadata and a list of services.

3.9.7 Query action

The basic URL is `a=q&s=TextQuery&c=demo&rt=d/r`. There are three query services which have been implemented: `TextQuery`, `FieldQuery`, and `AdvancedFieldQuery`. These are all handled in the same way by query action. For each page, the service description is requested from the service of the current collection (via a `describe` request). This is currently done every time the query page is displayed, but should be cached. The description includes a list of the parameters available for the query, such as `case/stem`, `max num docs to return`, etc. If the request type (`rt`) parameter is set to `d` for display, the action only needs to display the form, and this is the only request to the service. Otherwise, the submit button has been pressed, and a query request to the `TextQuery` service is sent. This has all the parameters from the URL put into the parameter list. A list of document identifiers is returned. A followup query is sent to the `MetadataRetrieve` service of the collection: the content includes the list of documents, with a request for some of their metadata. Which metadata to retrieve is determined by looking through the XSLT that will be used to transform the page. The service description and query result are combined into a page of XML, which is returned to the Receptionist.

3.9.8 Applet action

There are two types of request to the applet action: `a=a & rt=d` and `a=a & rt=r`. The value `rt=d` means "display the applet." A `describe` request is sent to the service, which returns the `<applet>` HTML element. The transformation file `applet.xsl` embeds this into the page, and the servlet returns the HTML.

The value `rt=r` signals a request from the applet. A process request containing all the parameters is sent to the applet service. The result contains an `appletData` element, which contains a single element - this element is returned directly to the applet, in XML. No transformation is done. Because the `AppletAction` doesn't know or care anything about the applet data, it can work with any applet-service pair.

Note that the applet HTML may need to know the name of the `library` program. However, that name is chosen by the person who installed the software and will not necessarily be "library". To get around this, the applet can put a parameter called "library" into the applet data with a null value:

```
<PARAM NAME='library' VALUE='' />
```

When the `AppletAction` encounters this parameter it inserts the name of the current library servlet as its value.

3.9.9 Document action

DocumentAction is responsible for displaying a document to the user. The display might involve some metadata and/or text for a document or part of a document. For hierarchical documents, a table of contents may be shown, while for paged documents (those with a single linear list of sections), next and previous page buttons may be shown. These different display types require different information about the document. Depending on the arguments, DocumentAction will send requests to several services: DocumentMetadataRetrieve, DocumentStructureRetrieve and DocumentContentRetrieve.

A basic display, for example, Title and text, involves a metadata request to get the Title, and a content request to get the text. Hierarchical table of contents display requires a structure request. If the entire contents is to be displayed, the parameter `structure=entire` would be sent in the request. Otherwise, parameters `structure=ancestors`, `structure=children` and possibly `structure=siblings` may be used, depending in the position of the current node in the document. These return a hierarchical structure of nodes, containing ancestor nodes, child nodes and sibling nodes, respectively. For paged display, the structure is not actually needed. A structure request is still sent, but this time it requests some information, rather the structure itself. The information requested includes the number of siblings and the current position of the current node, or the number of children (if the current node is the root of the document).

Metadata may be requested for the current node, or for any nodes in the structure, and content also. The metadata and content are added into the appropriate nodes in the structure hierarchy, and this is returned as the page data.

3.9.10 XML Document action

XMLDocumentAction is a little different to the standard DocumentAction. It operates in two modes, `text` and `toc`. In `text` mode, it will retrieve the content of the current document node using a DocumentContentRetrieve request. In `toc` mode, it retrieves the entire table of contents for the document using a DocumentStructureRetrieve request. Either mode may also retrieve metadata for the current section or each section in the table of contents.

3.9.11 GS2Browse action

GS2BrowseAction is for displaying Greenstone 2 style classifiers.

3.9.12 System action

SystemAction allows for manual reconfiguration of various components at runtime. There is no interactive web-page displaying the options, it merely turns a set of CGI arguments into an XML system request. The response from a system request is a message which is displayed to the user.

Table 9: Configure CGI arguments

arg	description
a=s	system action
sa=c a d	type of system request: c (configure), a (add/activate), d (delete/deactivate)
c=demo	the request will go to this collection/servicecluster instead of the message router
ss=collectionList	subset for configure: only reconfigure this part. For the MessageRouter, can be serviceClusterList, serviceList, collectionList, siteList. For a collection/cluster, can be metadataList or serviceList.
sn=demo	
st=collection	

3.10 Other code information

Greenstone has a set of Utility classes, which are briefly described in Table 10.

Table 10: The utility classes in org.greenstone.gsd13.util

Utility class	Description
Dictionary	wrapper around a Resource Bundle, providing strings with parameters
GSConstants	holds some constants used for servlet arguments and configuration variables
GSEntityResolver	an EntityResolver which can be used to find resources such as DTDs
GSFile	class to create all Greenstone file paths e.g. used to locate configuration files, XSLT files and collection data.
GSHTML	provides convenience methods for dealing with HTML, e.g. making strings HTML safe
GSParams	contains names and default values for interface parameters
NZDLParams	a subclass of GSParams which holds default service parameters too, necessary for the classic style interface.
GSPath	used to create, examine and modify message address paths
GSSQL	contains static strings for all the SQL table/field names
GSStatus	some static codes for status messages
GSXML	lots of methods for extracting information out of Greenstone XML, and creating some common types of elements. Also has static Strings for element and attribute names used by Greenstone .
GSXSLT	some manipulation functions for Greenstone XSLT
Misc	miscellaneous functions
OID	class to handle Greenstone (2) OIDs
GS3OID	subclass of OID to handle Greenstone 3 OIDs
SQLQuery	contains a connection to a SQL database, along with some methods for accessing the data, such as converting MG numbers to and from Greenstone OIDs.
XMLConverter	provides methods to create new Documents, parse Strings or Files into Documents, and convert Nodes to Strings
XMLTransformer	methods to transform XML using XSLT
XSLTUtil	contains static methods to be called from within XSLT

4 Collection building architecture

**** GEORGE **** how building actually works
the building structure/architecture
modules API

5 Developing Greenstone 3 : Adding new features

5.1 Creating new services

*inherit from ServiceRack - abstract base class. this handles the main process method, determines the service name and request type. if request type is describe, and to is empty, it returns a list of services (short_service_info) which is initialised in the configure method. a describe request to a particular service results in get-ServiceDescription being called, which must be supplied by the subclass. other request types (process) get sent to processXXX methods, where XXX is the service name.

- * what methods are expected

- *service type responses expected

- *a browse type service must also implement servicenameMetadataRetrieve service.

- * should a metadata retrieval service advertise what metadata is available??

standard service type vs new service type - standard needs some xml response syntax.

5.2 creating new actions/pages

5.3 new interfaces

It is easy to create new interfaces to Greenstone 3. Here we are talking about interfaces other than those to display in typical browser.

Handheld devices: Use the standard servlet setup, but with a different set of XSLT files to format the pages for small screens, or use WML.

Java GUI Interface: There are couple of alternatives. Depending on what you want to display in the GUI, you could talk to either a Receptionist or a MessageRouter. The library classes can be set up and compiled into the GUI program. Talking to a Receptionist will give you access to pages of XML. It is likely that the standard Receptionist class would be used - this doesn't transform the data to HTML. Queries such as "give me the home page of a collection" and "do the following search" can be issued. All the data needed for the result view is returned. Queries are quite simple, but are limited to what kinds of Actions are available in the library. Talking to a MessageRouter requires a bit more effort on the part of the GUI program, but results in greater flexibility. The kinds of queries that can be issued are individual units of action, such as "describe yourself", "search", "retrieve the content for this document". More than one request may need to be made for a particular feature of the GUI. However you can ask for any combination of data available in the system, you are not relying on Actions. What you will implement though, may be a lot like the Action code in terms of request sequences.

Interfaces in other programming languages: Because the communication is all XML based, other interfaces can talk to the Java library if a communication protocol is set up. This could be done using SOAP for example. Like for Java GUI

interfaces, the program could talk to a Receptionist or to a MessageRouter. e.g. java interface. where you can interface to. MR vs Receptionist. diff receptionists. egs, handheld - using servlet, transforming recpt, but new set of XSLT java program other program - talk to recpt but just get back XML data for pages. java gui - just talk to MR, do all processing itself.

Remote interfaces: remote interfaces can be set up in the same way as above, using a communication protocol between the interface, and the library program.

5.4 Adding new classifiers

*** GEORGE ***

5.5 Adding new plugins

*** GEORGE ***

5.6 New types of collections

There are two types of standard Greenstone collections: collections built with the Greenstone 3 building system, and collections that are imported from Greenstone 2 . There are many options to collection building but it is conceivable that these options don't meet the needs of all collection builders. Greenstone 3 has an ability to use any type of collection you can come up with, assuming some java code is provided.

There are four levels of customisation that may be needed with new collections: service, collection, interface XSLT, and action levels. We will use the example collections that come with Greenstone to describe these different levels.

Firstly, new service classes need to be written to provide the functionality to search/browse/whatever the collection. If the services have similar interfaces and functionality to the standard services, this may be all that is needed. For example, the Greenstone 2 MGPP collections were the first to be served in Greenstone 3 . When we came to do Greenstone 2 MG collections, all we had to do was write some new service classes that interacted with MG instead of MGPP. Because these collections used the same type of services, this was all we had to do. The format of the configuration files was similar, they just specified MG serviceRack classes rather than MGPP ones.

The XML Sample Texts (gberg) collection, however, was done quite differently to the standard collections. New services were provided to search the database (built with Lucene) and to provide the documents and parts of documents (using XSLT to transform the raw XML files). The collectionConfig file had some extra information in it: a list of the documents in the collection along with their Titles. Because the standard collection class has no notion of document lists, a new class was created (org.greenstone.gsd13.collection.XMLCollection). This class is basically the same as a standard collection class except that it looks for and stores in

memory the `documentList` from the `collectionConfig` file.

To tell Greenstone to load up a different type of collection class, we use another configuration file: `etc/collectionInit.xml`. This specifies the name of the collection class to use. Currently, this is all that is specified in that file, but you may want to add parameters for the class etc.

```
<collectionInit class="XMLCollection"/>
```

The display for the collection is also quite different. The home page for the collection displays the list of documents. To achieve this, the describe response from the collection had to include the list, and a new XSLT was written for the collection that displayed this. Collection XSLT should be put in the transform directory of the collection¹³.

Document display is significantly different to standard Greenstone . There are two modes of display: table of contents mode, and content mode. Clicking on a document link from the collection home page takes the user to the table of contents for the collection. Clicking on one of the sections in the table of contents takes them to a display of that section. To facilitate this, not only do we need new XSLT files , we also needed a new action. `XMLDocumentAction` was created, that used two subactions, `toc` and `text`, for the different modes of display.

The Receptionist was told about this new action by the addition of the following element to the `interfaceConfig.xml` file:

```
<action name='xd' class='XMLDocumentAction'>
  <subaction name='toc' xslt='document-toc.xsl' />
  <subaction name='text' xslt='document-content.xsl' />
</action>
```

XSLT files are linked to subactions rather than the action as a whole. The collection supplies the two XSLT files written appropriately for the data it contains.

All links that link to the documents have to be changed to use the `xd` action rather than the standard `d` action. These include the links from the home page, and the links from query results.

Querying of the collection is almost the same as usual. The query service provides a list of parameters, does the query and then sends back a list of document identifiers. The standard query action was fine for this collection. The change occurs in the way that the results are displayed—this is accomplished using a format statement supplied in the `collectionConfig` file inside the search node.

```
<search>
  <format>
    <gsf:template match="documentNode">
      <xsl:param name="collName"/>
      <xsl:param name="serviceName"/>
      <td>
        <b><a href="{ $library_name }?a=xd&sa=text&c={ $collName }&
```

¹³These are currently only used when running Greenstone in a non-distributed fashion, but it will be added in properly at some stage

```

&amp;d={@nodeID}&amp;p.a=q&amp;p.s={ $serviceName } ">
<xsl:choose>
  <xsl:when test="metadataList/metadata[@name='Title']">
    <gsf:metadata name="Title"/>
  </xsl:when>
  <xsl:otherwise>(section)</xsl:otherwise>
</xsl:choose>
</a>
</b> from <b><a href="{ $library_name }?a=xd&sa=toc&
c={ $collName }&d={@nodeID}.rt&p.a=q&p.s={ $serviceName } ">
<gsf:metadata name="Title" select="root"/></a></b>
</td>
</gsf:template>
</format>
</search>

```

Instead of displaying an icon and the Title, it displays the Title of the section and the title of the document. Both of these are linked to the document: the section title to the content of that section, the document title to the table of contents for the document. Because these require non-standard arguments to the library, these parts of the template are written in XSLT not Greenstone format language. As is shown here it is perfectly feasible to write a format statement that includes XSLT mixed in with Greenstone format elements.

The document display uses CSS to format the output—these are kept in the collection and specified in the collections XSLT files. The documents also specify DTD files. Due to the way we read in the XML files, Tomcat sometimes has trouble locating the DTDs. One option is to make all the links absolute links to files in the collection folder, the other option is to put them in Greenstone 's DTD folder `gsdl3/resources/dtd`.

5.7 The Classic Interface

The library seen at <http://www.greenstone.org/greenstone3/nzdl> is like a mirror to <http://www.nzdl.org>—it aims to present the same collections, in the same way but using Greenstone 3 instead of Greenstone 2 . It uses a new site (nzdl) with the classic interface. The web.xml file had a new servlet entry in it to specify the combination of nzdl site and classic interface.

The site was created by making a directory called nzdl in the sites folder. A siteConfig file was created. Because it is running on Linux, we were able to link to all the collections in the old Greenstone installation. The `convert_coll_from_gs2.pl` script was run over all the collections to produce the new XML configuration files.

The classic interface was created to be used by this site (and is now a standard part of Greenstone). In many cases, creating a new interface just requires the new images and XSLT to be added to the new directory(see Sections 1.4 and 2.6). This classic interface required a bit more customisation.

The standard Greenstone 3 navigation bar lists all the services available for the collection. In Greenstone 2 , the navigation bar provides the search option,

and the different classifiers. This is not service specific, but hard coded to the search and classifiers. The XSLT that produces the navigation bar needed to be altered to produce this. But also, a new Receptionist was needed. The standard receptionist (DefaultReceptionist) gathers a little bit of extra information for each page of XML before transforming it: this is the list of services for the collection and their display information, allowing the services to be listed along the navigation bar. This is information that is needed by every page (except for the library home page) and therefore is obtained by the receptionist instead of by each action. The nzdl interface needed a bit more information than this: for the ClassifierBrowse service, if there was one, the list of classifiers and their display elements must be obtained. So a new Receptionist (NZDLReceptionist) was written that inherited from DefaultReceptionist, and added this new info into the page.

One of the servlet initialisation parameters is the receptionist class: this was added to the servlet definition in the web.xml file so that the LibraryServlet would load up the right receptionist class.

6 Distributed Greenstone

Greenstone is designed to run in a distributed fashion. One Greenstone installation can talk to several sites on different computers. This requires some sort of communication protocol. Any protocol can be used, currently we have a simple SOAP protocol.

more explanation..

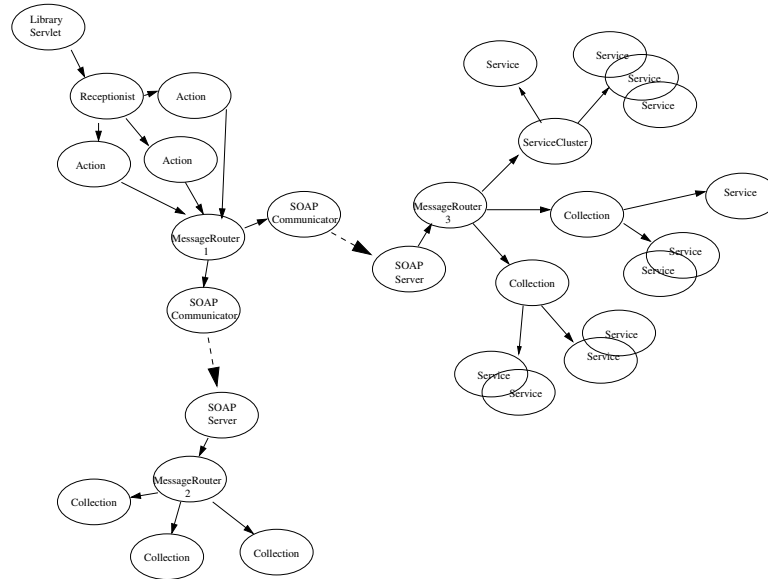


Figure 11: A distributed digital library configuration running over several servers

We have used Apache SOAP for Java. This is run as a servlet in Tomcat. Tomcat in Greenstone comes set up to use SOAP, but it is not enabled. To enable it, run `gs3-enable-soap.sh/bat`. For more details about SOAP in Greenstone, see Appendix C. Debugging soap is described in Appendix C.1.

6.1 Serving a site using soap

A script has been created to setup a SOAP server for a site. On Linux, from the `gsdl3` directory, run `./gs3-soap-deploy-site.sh <sitename> <siteuri>`

Sitename is the name of the site's directory, e.g. `localsite`. The siteuri is the identifier that will be used for the SOAP resource, e.g. `org.greenstone.localsite`. It should be a unique name amongst all the SOAP services that you want to connect to.

The script deploys the service for the site specified. A resource file (`sitename.xml`) is created which is used to specify the service. It can be found in `gsdl3/resources/soap`, and is generated from `site.xml.in`.

To get siteA to talk to siteB, you need to deploy a SOAP server on siteB,

then add a `<site>` element to the `<siteList>` of siteA's `siteConfig.xml` file (in `gsdl3/web/sites/siteA/siteConfig.xml`).

In the `<siteList>` element, add the following (substituting the chosen site uri for `siteAuri`):

```
<site name="siteAuri"  
  address="http://localhost:8080/soap/servlet/rpcrouter"  
  type="soap"/>
```

(Note that `localhost` and `8080` should be changed to the values you entered when installing Greenstone 3).

A Using Greenstone 3 from CVS

[TODO: need to make sure building stuff is in here]

Greenstone 3 is also available via CVS. You can download the latest version of the code. This is not guaranteed to be stable, in fact it is likely to be unstable. The advantage of using CVS is that you can update the code and get the latest fixes.

Note that you will need the Java 2 SDK, version 1.4.0 or higher.

To check out the Greenstone code, use:

```
cvs -d :pserver:cvs\_anon@cvs.scms.waikato.ac.nz:2402/usr/local/  
global-cvs/gsd1-src co -P gsd13
```

If you need it, the password for anonymous CVS access is `anonymous`. Note that some older versions of CVS have trouble accessing this repository due to the port number being present. We are using version 1.11.1p1.

The software needs to be compiled and installed. The installation procedure uses a shell script or batch file. The most up to date instructions may be found in the README.txt file in the top level gsd13 directory.

To install Greenstone once you have checked it out of CVS, do the following (alternatives for Linux or Windows):

```
cd gsd13  
./gs3-install.sh or gs3-install  
source gs3-setup.sh or gs3-setup
```

To recompile the code at any stage, you can use

```
source gs3-setup.sh or gs3-setup  
make  
make install
```

Note: `gs3-setup` sets the environment variables `CLASSPATH`, `PATH`, `JAVA_HOME` and needs to be done in a shell before doing collection building etc.

To startup or shutdown the library (includes the Tomcat server and MYSQL server), the commands are (run from the gsd13 directory):

```
./gs3-launch.sh or gs3-launch ./gs3-launch.sh -shutdown or  
close the window
```

B Tomcat

Tomcat is a servlet container. It is used to serve a Greenstone site using a servlet.

The file `$GSDL3HOME/comms/jakarta/tomcat/conf/server.xml` is the Tomcat configuration file. The installation process adds a context for Greenstone 3 servlets (`$GSDL3HOME/web`)—this tells Tomcat where to find the `web.xml` file, and what URL (`/gsdl3`) to give it. Anything inside the context directory is accessible via Tomcat¹⁴. For example, the `index.html` file that lives in `$GSDL3HOME/web` can be accessed through the URL `localhost:8080/gsd13/index.html`. The demo collection's images can be accessed through

`localhost:8080/gsd13/sites/localsite/collect/demo/images/`.

Tomcat runs by default on port 8080—this can be changed in `server.xml`, in the

```
<!-- Define a non-SSL Coyote HTTP/1.1 Connector on port 8080
-->
<Connector>
```

element. The `siteConfig` files also need changing if Tomcat's port is changed: `<httpAddress>` for the site, and `<address>` for a remote site both use this.

Note: Tomcat must be shutdown and restarted any time you make changes in the following for those changes to take effect:

- `$GSDL3HOME/web/WEB-INF/web.xml`
- `$GSDL3HOME/comms/jakarta/tomcat-tomcat-4.0.1/conf/server.xml`
- any classes or jar files used by the servlets

Note: `stdin` and `stdout` for the servlets both go to

`$GSDL3HOME/comms/jakarta/tomcat/logs/catalina.out`

On startup, the servlet loads in its collections and services. If the site or collection configuration files are changed, these changes will not take effect until the site/collection is reloaded. This can be done through the reconfiguration messages (see Section 1.7), or by restarting Tomcat.

We have set up Tomcat to follow symlinks. To disable this feature, remove the `<Resources>` element from the `gsdl3` context in

`$GSDL3HOME/comms/jakarta/tomcat/conf/server.xml`:

```
<Context path="/gsdl3" docBase="$GSDL3HOME/web" debug="1"
reloadable="true">
<Resources allowLinking='true' />
</Context>
```

We have set up Tomcat to disallow directory listings for everything in the `docBase` directory. To turn this back on, you need to edit Tomcat's default `web.xml` file (`$GSDL3HOME/comms/jakarta/tomcat/conf/web.xml`):

¹⁴can we use `.htaccess` files to restrict access??

In the default servlet definition, change the 'listings' parameter to true.

Tomcat uses a Manager to handle HTTP session information. This may be stored between restarts if possible. To use a persistent session handling manager, uncomment the `<Manager>` element in

`$GSDL3HOME/comms/jakarta/tomcat/conf/server.xml`. For the default manager, session information is stored in the work directory:

`$GSDL3HOME/comms/jakarta/tomcat/work/Standalone/localhost/gsd13/SESSIONS.ser`. Delete this file to clear the cached session info.

B.1 Proxying Tomcat with apache

Instead of incorporating servlet support into your existing web server, an easy alternative is to proxy Tomcat. The `http://www.greenstone.org/greenstone3` site uses apache to proxy Tomcat. `ProxyPass` and `ProxyPassReverse` directives need to be added to the Virtualhost description for the `www.greenstone.org` server.

```
<VirtualHost xx.xx.xx.xx>
  ServerName www.greenstone.org
  ...
  ProxyPass /greenstone3 http://puka.cs.waikato.ac.nz:8080/gsd13
  ProxyPassReverse /greenstone3 http://puka.cs.waikato.ac.nz:8080/gsd13
</VirtualHost>
```

In our example, the Greenstone 3 servlet can be accessed at `http://www.greenstone.org/greenstone3/library`, instead of at `http://puka.cs.waikato.ac.nz:8080/gsd13/library`, which is not publically accessible.

B.2 Running Tomcat behind a proxy

Almost everything works fine when Tomcat is running behind a proxy. The only time this causes trouble is if the servlet itself needs to make external http connections. We do this in the infomine demo collection for example. One of the service classes sends http requests to the infomine database at riverside. Since this is going through the proxy, a username and password is needed. It is not sufficient to prompt the user for a password because they are unlikely to have a password for the particular proxy that Tomcat is using. What we have done at present is to put a proxy element in the `siteConfig.xml` file. Here you have to enter a suitable username and password for the proxy server. Unfortunately these are entered in plain text. And the file is viewable via the servlet. So we need a better solution.

C SOAP

Grenstone uses Apache SOAP for distributed communications. This runs as a servlet inside Tomcat, and services can be deployed by the servlet. The SOAP servlet comes ready to run, but not enabled. To enable it, run:

```
gs3-enable-soap.[sh/bat]
```

All this does is to rename the SOAP `web.xml.disabled` file to `web.xml`.

The SOAP service for localsite comes pre-deployed. To get the gateway servlet talking to the localsite SOAP server, you need to shutdown and restart Tomcat. You should now see more collections when you run the gateway servlet.

To deploy a SOAP service for other sites, run

```
gs3-soap-deploy-site.[sh/bat] <sitename> <siteURI>
```

This creates a new `SOAPServer` class for the site (`$GSDL3HOME/src/java/org/greenstone/gsd13/SOAPServer`), creates a resource file for deployment (`$GSDL3HOME/resources/soap/<sitename>.xml`), and then tries to deploy the service. If the deployment doesn't work, you can run it from the command line like:

```
java org.apache.soap.server.ServiceManagerClient
http://localhost:8080/soap/servlet/rpcrouter deploy
resources/soap/<sitename>.xml
```

You can also deploy a service through the website. If Tomcat is not running, start it up.

The SOAP servlet can be accessed at `http://localhost:8080/soap`. You should see a welcome page. Click on "Run the admin client". This enables you to list, deploy and undeploy SOAP services.

To deploy the `SOAPServer` for `siteX`:

Click on "deploy" and edit the following fields in the deploy form:

ID:	<code>siteX</code>
Scope: (choose Session or Application)	Request—new instantiation for each request Session—same instantiation across a session Application—only uses one instantiation process
Methods:	
Java Provider / Provider Class:	<code>org.greenstone.gsd13.SOAPServersiteX</code>

Now click the "deploy" button at the bottom of the page. If the service has been deployed, it should appear when you click on the left hand "List" button.

Information about deployed services is maintained between Tomcat sessions—you only need to deploy it once.

C.1 Debugging SOAP

If you need to debug the SOAP stuff for some reason, or just want to look at the SOAP messages that are being passed back and forth, use a program called `TcpTunnelGui`. This intercepts messages coming in to one port, displays them, and passes them to another port. To run it, type:

```
java org.apache.soap.util.net.TcpTunnelGui 8070 localhost
8080
```

8070 is the port that `TcpTunnelGui` listens on, and 8080 is the port that it sends the messages onto—the port that Tomcat is using. You need to modify Greenstone to talk to port 8070 when it wants to talk to Tomcat, so that the messages go through `TcpTunnelGui`. This is specified in the `<site>` element of the gateway site configuration file (`$GSDL3HOME/web/sites/gateway/siteConfig.xml`).

```
<site name="org.greenstone.localsite"
      address="http://localhost:8080/soap/servlet/rpcrouter"
      type="soap"/>
```

Note that `http://localhost:8080/soap/servlet/rpcrouter` is the address for talking to the Tomcat SOAP servlet services.

D Format statements: Greenstone 2 vs Greenstone 3

The following table shows the Greenstone 2 format elements, and their equivalents in Greenstone 3

Table 11: Greenstone 3 equivalents of Greenstone 2 format statements

Greenstone 2	Greenstone 3
[Text]	<gsf:text/>
[num]	<gsf:metadata name='docnum' />
[link] [/link]	<gsf:link></gsf:link> or <gsf:link type='document'></gsf:link>
[srclink] [/srclink]	<gsf:link type='source'></gsf:link>
[icon]	<gsf:icon/> or <gsf:icon type='document' />
[srcicon]	<gsf:icon type='source' />
[Title] (metadata)	<gsf:metadata name='Title' /> or <gsf:metadata name='Title' select='current' />
[parent:Title]	<gsf:metadata name='Title' select='parent' />
[parent(All):Title]	<gsf:metadata name='Title' select='ancestors' />
[parent(Top):Title]	<gsf:metadata name='Title' select='root' />
[parent(All': '):Title]	<gsf:metadata name='Title' select='ancestors' separator=': ' />
[sibling(All': '):Title]	<gsf:metadata name='Title' multiple='true' separator=': ' />
{Or}{[dc.Title], [dls.Title], [Title]}	<gsf:choose-metadata> <gsf:metadata name='dc.Title' /> <gsf:metadata name='dls.Title' /> <gsf:metadata name='Title' /> </gsf:choose-metadata>
{If}{[parent:Title], [parent:Title], [Title]}	<gsf:choose-metadata> <gsf:metadata name='Title' select='parent' /> <gsf:metadata name='Title' /> </gsf:choose-metadata>
{If}{[Subject], <td>[Subject]</td>}	<gsf:switch> <gsf:metadata name='Subject' /> <gsf:when test='exists'> <td><gsf:metadata name='Subject' /></td> </gsf:when></gsf:switch>