

```
1: // $Id: sockets.h,v 1.2 2014-05-23 22:17:25-07 - - $
2:
3: #ifndef __SOCKET_H__
4: #define __SOCKET_H__
5:
6: #include <cstring>
7: #include <stdexcept>
8: #include <string>
9: #include <vector>
10: using namespace std;
11:
12: #include <arpa/inet.h>
13: #include <netdb.h>
14: #include <netinet/in.h>
15: #include <string>
16: #include <sys/socket.h>
17: #include <sys/types.h>
18: #include <sys/wait.h>
19: #include <unistd.h>
20:
21: //
22: // class base_socket:
23: // mostly protected and not used by applications
24: //
25:
26: class base_socket {
27:     private:
28:         static constexpr size_t MAXRECV = 0xFFFF;
29:         static constexpr int CLOSED_FD = -1;
30:         int socket_fd {CLOSED_FD};
31:         sockaddr_in socket_addr;
32:         base_socket (const base_socket&) = delete; // prevent copying
33:         base_socket& operator= (const base_socket&) = delete;
34:     protected:
35:         base_socket(); // only derived classes may construct
36:         ~base_socket();
37:         // server_socket initialization
38:         void create();
39:         void bind (const in_port_t port);
40:         void listen() const;
41:         void accept (base_socket&) const;
42:         // client_socket initialization
43:         void connect (const string host, const in_port_t port);
44:         // accepted_socket initialization
45:         string to_string_socket_fd() { return to_string (socket_fd); }
46:         void set_socket_fd (int fd);
47:     public:
48:         void close();
49:         ssize_t send (const void* buffer, size_t bufsize);
50:         ssize_t recv (void* buffer, size_t bufsize);
51:         void set_non_blocking (const bool);
52:         friend string to_string (const base_socket& sock);
53: };
54:
```

```
55:
56: //
57: // class accepted_socket
58: // used by server when a client connects
59: //
60:
61: class accepted_socket: public base_socket {
62:     public:
63:         accepted_socket() {}
64:         accepted_socket(int fd) { set_socket_fd (fd); }
65:         string to_string_socket_fd() {
66:             return base_socket::to_string_socket_fd();
67:         }
68: };
69:
70: //
71: // class client_socket
72: // used by client application to connect to server
73: //
74:
75: class client_socket: public base_socket {
76:     public:
77:         client_socket (string host, in_port_t port);
78: };
79:
80: //
81: // class server_socket
82: // single use class by server application
83: //
84:
85: class server_socket: public base_socket {
86:     public:
87:         server_socket (in_port_t port);
88:         void accept (accepted_socket& sock) {
89:             base_socket::accept (sock);
90:         }
91: };
92:
```

```
93:
94: //
95: // class socket_error
96: // base class for throwing socket errors
97: //
98:
99: class socket_error: public runtime_error {
100:     public:
101:         explicit socket_error (const string& what): runtime_error(what){}
102: };
103:
104: //
105: // class socket_sys_error
106: // subclass to record status of extern int errno variable
107: //
108:
109: class socket_sys_error: public socket_error {
110:     public:
111:         int sys_errno;
112:         explicit socket_sys_error (const string& what):
113:             socket_error(what + ": " + strerror (errno)),
114:             sys_errno(errno) {}
115: };
116:
117: //
118: // class socket_h_error
119: // subclass to record status of extern int h_errno variable
120: //
121:
122: class socket_h_error: public socket_error {
123:     public:
124:         int host_errno;
125:         explicit socket_h_error (const string& what):
126:             socket_error(what + ": " + hstrerror (h_errno)),
127:             host_errno(h_errno) {}
128: };
129:
```

```
130:
131: //
132: // class hostinfo
133: // information about a host given hostname or IPv4 address
134: //
135:
136: class hostinfo {
137:     public:
138:         const string hostname;
139:         const vector<string> aliases;
140:         const vector<in_addr> addresses;
141:         hostinfo (); // localhost
142:         hostinfo (hostent*);
143:         hostinfo (const string& hostname);
144:         hostinfo (const in_addr& ipv4_addr);
145:         friend string to_string (const hostinfo&);
146: };
147:
148: string localhost();
149: string to_string (const in_addr& ipv4_addr);
150:
151: #endif
152:
```

```
1: // $Id: signal_action.h,v 1.5 2014-05-27 17:16:42-07 - - $
2:
3: #ifndef __SIGNAL_ACTION_H__
4: #define __SIGNAL_ACTION_H__
5:
6: #include <stdexcept>
7: using namespace std;
8:
9: #include <signal.h>
10:
11: class cix_exit: public exception{};
12:
13: class signal_action {
14:     private:
15:         struct sigaction action;
16:     public:
17:         signal_action (int signal, void (*handler) (int));
18: };
19:
20: class signal_error: runtime_error {
21:     public:
22:         int signal;
23:         explicit signal_error (int signal);
24: };
25:
26: #endif
27:
```

[illegible]

```
1: // $Id: logstream.h,v 1.2 2014-05-27 13:40:23-07 - - $
2:
3: //
4: // class logstream
5: // replacement for initial cout so that each call to a logstream
6: // will prefix the line of output with an identification string
7: // and a process id. Template functions must be in header files
8: // and the others are trivial.
9: //
10:
11: #ifndef __LOGSTREAM_H__
12: #define __LOGSTREAM_H__
13:
14: #include <cassert>
15: #include <iostream>
16: #include <string>
17: #include <vector>
18: using namespace std;
19:
20: #include <sys/types.h>
21: #include <unistd.h>
22:
23: class logstream {
24:     private:
25:         ostream& out;
26:         string execname_;
27:     public:
28:
29:         // Constructor may or may not have the execname available.
30:         logstream (ostream& out, const string& execname = ""):
31:             out (out), execname_ (execname) {
32:         }
33:
34:         // First line of main should set_execname if logstream is global.
35:         void set_execname (const string& name) { execname_ = name; }
36:         string execname() { return execname_; }
37:
38:         // First call should be the logstream, not cout.
39:         // Then forward result to the standard ostream.
40:         template <typename T>
41:         ostream& operator<< (const T& obj) {
42:             assert (execname_.size() > 0);
43:             out << execname_ << "(" << getpid() << "): " << obj;
44:             return out;
45:         }
46:
47: };
48:
49: #endif
50:
```

```
1: // $Id: sockets.cpp,v 1.1 2014-05-23 22:02:59-07 - - $
2:
3: #include <cerrno>
4: #include <cstring>
5: #include <iostream>
6: #include <sstream>
7: #include <string>
8: using namespace std;
9:
10: #include <fcntl.h>
11: #include <limits.h>
12:
13: #include "sockets.h"
14:
15: base_socket::base_socket() {
16:     memset (&socket_addr, 0, sizeof (socket_addr));
17: }
18:
19: base_socket::~~base_socket() {
20:     if (socket_fd != CLOSED_FD) close();
21: }
22:
23: void base_socket::close() {
24:     int status = ::close (socket_fd);
25:     if (status < 0) throw socket_sys_error ("close");
26:     socket_fd = CLOSED_FD;
27: }
28:
29: void base_socket::create() {
30:     socket_fd = ::socket (AF_INET, SOCK_STREAM, 0);
31:     if (socket_fd < 0) throw socket_sys_error ("socket");
32:     int on = 1;
33:     int status = ::setsockopt (socket_fd, SOL_SOCKET, SO_REUSEADDR,
34:                               &on, sizeof on);
35:     if (status < 0) throw socket_sys_error ("setsockopt");
36: }
37:
38: void base_socket::bind (const in_port_t port) {
39:     socket_addr.sin_family = AF_INET;
40:     socket_addr.sin_addr.s_addr = INADDR_ANY;
41:     socket_addr.sin_port = htons (port);
42:     int status = ::bind (socket_fd, (sockaddr*) &socket_addr,
43:                          sizeof socket_addr);
44:     if (status < 0) throw socket_sys_error ("bind(" + to_string (port)
45:                                             + ")");
46: }
47:
48: void base_socket::listen() const {
49:     int status = ::listen (socket_fd, SOMAXCONN);
50:     if (status < 0) throw socket_sys_error ("listen");
51: }
52:
```



```
53:
54: void base_socket::accept (base_socket& new_socket) const {
55:     int addr_length = sizeof new_socket.socket_addr;
56:     new_socket.socket_fd = ::accept (socket_fd,
57:                                     (sockaddr*)&new_socket.socket_addr,
58:                                     (socklen_t*)&addr_length);
59:     if (new_socket.socket_fd < 0) throw socket_sys_error ("accept");
60: }
61:
62: ssize_t base_socket::send (const void* buffer, size_t bufsize) {
63:     int nbytes = ::send (socket_fd, buffer, bufsize, MSG_NOSIGNAL);
64:     if (nbytes < 0) throw socket_sys_error ("send");
65:     return nbytes;
66: }
67:
68: ssize_t base_socket::recv (void* buffer, size_t bufsize) {
69:     memset (buffer, 0, bufsize);
70:     ssize_t nbytes = ::recv (socket_fd, buffer, bufsize, 0);
71:     if (nbytes < 0) throw socket_sys_error ("recv");
72:     return nbytes;
73: }
74:
75: void base_socket::connect (const string host, const in_port_t port) {
76:     struct hostent *hostp = ::gethostbyname (host.c_str());
77:     if (hostp == NULL) throw socket_h_error ("gethostbyname("
78:                                     + host + ")");
79:     socket_addr.sin_family = AF_INET;
80:     socket_addr.sin_port = htons (port);
81:     socket_addr.sin_addr = *(in_addr*) hostp->h_addr;
82:     int status = ::connect (socket_fd, (sockaddr*)&socket_addr,
83:                             sizeof (socket_addr));
84:     if (status < 0) throw socket_sys_error ("connect(" + host + ":"
85:                                     + to_string (port) + ")");
86: }
87:
88: void base_socket::set_socket_fd (int fd) {
89:     socket_fd = fd;
90:     socklen_t addrlen = sizeof socket_addr;
91:     int rc = getpeername (socket_fd, (sockaddr*)&socket_addr, &addrlen);
92:     if (rc < 0) throw socket_sys_error ("getpeername");
93:     if (socket_addr.sin_family != AF_INET)
94:         throw socket_error ("address not AF_INET");
95: }
96:
97: void base_socket::set_non_blocking (const bool blocking) {
98:     int opts = ::fcntl (socket_fd, F_GETFL);
99:     if (opts < 0) throw socket_sys_error ("fcntl");
100:    if (blocking) opts |= O_NONBLOCK;
101:        else opts &= compl O_NONBLOCK;
102:    opts = ::fcntl (socket_fd, F_SETFL, opts);
103:    if (opts < 0) throw socket_sys_error ("fcntl");
104: }
105:
```

```
106:
107: client_socket::client_socket (string host, in_port_t port) {
108:     base_socket::create();
109:     base_socket::connect (host, port);
110: }
111:
112: server_socket::server_socket (in_port_t port) {
113:     base_socket::create();
114:     base_socket::bind (port);
115:     base_socket::listen();
116: }
117:
118: string to_string (const hostinfo& info) {
119:     return info.hostname + " (" + to_string (info.addresses[0]) + ")";
120: }
121:
122: string to_string (const in_addr& ipv4_addr) {
123:     char buffer[INET_ADDRSTRLEN];
124:     const char *result = ::inet_ntop (AF_INET, &ipv4_addr,
125:                                       buffer, sizeof buffer);
126:     if (result == NULL) throw socket_sys_error ("inet_ntop");
127:     return result;
128: }
129:
130: string to_string (const base_socket& sock) {
131:     hostinfo info (sock.socket_addr.sin_addr);
132:     return info.hostname + " (" + to_string (info.addresses[0])
133:         + ") port " + to_string (ntohs (sock.socket_addr.sin_port));
134: }
135:
```

```
136:
137: string init_hostname (hostent* host) {
138:     if (host == nullptr) throw socket_h_error ("gethostbyname");
139:     return host->h_name;
140: }
141:
142: vector<string> init_aliases (hostent* host) {
143:     if (host == nullptr) throw socket_h_error ("gethostbyname");
144:     vector<string> init_aliases;
145:     for (char** alias = host->h_aliases; *alias != nullptr; ++alias) {
146:         init_aliases.push_back (*alias);
147:     }
148:     return init_aliases;
149: }
150:
151: vector<in_addr> init_addresses (hostent* host) {
152:     vector<in_addr> init_addresses;
153:     if (host == nullptr) throw socket_h_error ("gethostbyname");
154:     for (in_addr** addr = (in_addr**) host->h_addr_list;
155:          *addr != nullptr; ++addr) {
156:         init_addresses.push_back (**addr);
157:     }
158:     return init_addresses;
159: }
160:
161: hostinfo::hostinfo (hostent* host):
162:     hostname (init_hostname (host)),
163:     aliases (init_aliases (host)),
164:     addresses (init_addresses (host)) {
165: }
166:
167: hostinfo::hostinfo(): hostinfo (localhost()) {
168: }
169:
170: hostinfo::hostinfo (const string& hostname):
171:     hostinfo (::gethostbyname (hostname.c_str())) {
172: }
173:
174: hostinfo::hostinfo (const in_addr& ipv4_addr):
175:     hostinfo (::gethostbyaddr (&ipv4_addr, sizeof ipv4_addr,
176:                               AF_INET)) {
177: }
178:
179: string localhost() {
180:     char hostname[HOST_NAME_MAX];
181:     int rc = gethostname (hostname, sizeof hostname);
182:     if (rc < 0) throw socket_sys_error ("gethostname");
183:     return hostname;
184: }
185:
```

```
1: // $Id: signal_action.cpp,v 1.6 2014-05-27 17:16:42-07 - - $
2:
3: #include <cstring>
4: #include <string>
5: #include <unordered_map>
6: using namespace std;
7:
8: #include "signal_action.h"
9:
10: signal_action::signal_action (int signal, void (*handler) (int)) {
11:     action.sa_handler = handler;
12:     sigfillset (&action.sa_mask);
13:     action.sa_flags = 0;
14:     int rc = sigaction (signal, &action, nullptr);
15:     if (rc < 0) throw signal_error (signal);
16: }
17:
18: signal_error::signal_error (int signal):
19:     runtime_error (string ("signal_error(")
20:                     + strsignal (signal) + ")"),
21:     signal(signal) {}
22:
```

```
1: // $Id: cix_protocol.cpp,v 1.6 2014-05-27 17:16:42-07 - - $
2:
3: #include <unordered_map>
4: #include <string>
5: using namespace std;
6:
7: #include "cix_protocol.h"
8:
9: const unordered_map<int,string> cix_command_map {
10:     {int (CIX_ERROR), "CIX_ERROR"},
11:     {int (CIX_EXIT ), "CIX_EXIT" },
12:     {int (CIX_GET  ), "CIX_GET"  },
13:     {int (CIX_HELP ), "CIX_HELP" },
14:     {int (CIX_LS   ), "CIX_LS"   },
15:     {int (CIX_PUT  ), "CIX_PUT"  },
16:     {int (CIX_RM   ), "CIX_RM"   },
17:     {int (CIX_FILE ), "CIX_FILE" },
18:     {int (CIX_LSOUT), "CIX_LSOUT"},
19:     {int (CIX_ACK  ), "CIS_ACK"  },
20:     {int (CIX_NAK  ), "CIS_NAK"  },
21: };
22:
23:
24: void send_packet (base_socket& socket,
25:                  const void* buffer, size_t bufsize) {
26:     const char* bufptr = (const char*) buffer;
27:     ssize_t ntosend = bufsize;
28:     do {
29:         ssize_t nbytes = socket.send (bufptr, ntosend);
30:         if (nbytes < 0) throw socket_sys_error (to_string (socket));
31:         bufptr += nbytes;
32:         ntosend -= nbytes;
33:     }while (ntosend > 0);
34: }
35:
36: void recv_packet (base_socket& socket, void* buffer, size_t bufsize) {
37:     char* bufptr = (char*) buffer;
38:     ssize_t ntorecv = bufsize;
39:     do {
40:         ssize_t nbytes = socket.recv (bufptr, ntorecv);
41:         if (nbytes < 0) throw socket_sys_error (to_string (socket));
42:         if (nbytes == 0) throw socket_error (to_string (socket)
43:                                             + " is closed");
44:         bufptr += nbytes;
45:         ntorecv -= nbytes;
46:     }while (ntorecv > 0);
47: }
48:
49: ostream& operator<< (ostream& out, const cix_header& header) {
50:     const auto& itor = cix_command_map.find (header.cix_command);
51:     string code = itor == cix_command_map.end() ? "?" : itor->second;
52:     cout << "{" << header.cix_nbytes << ", " << code << " = "
53:          << int (header.cix_command) << ", \" " << header.cix_filename
54:          << "\"}";
55:     return out;
56: }
57:
```

```
58:
59: string get_cix_server_host (const vector<string>& args, size_t index) {
60:     if (index < args.size()) return args[index];
61:     char* host = getenv ("CIX_SERVER_HOST");
62:     if (host != nullptr) return host;
63:     return "localhost";
64: }
65:
66: in_port_t get_cix_server_port (const vector<string>& args,
67:                                size_t index) {
68:     string port = "-1";
69:     if (index < args.size()) port = args[index];
70:     else {
71:         char* envport = getenv ("CIX_SERVER_PORT");
72:         if (envport != nullptr) port = envport;
73:     }
74:     return stoi (port);
75: }
76:
```

```
1: // $Id: cix-daemon.cpp,v 1.3 2014-05-27 17:16:42-07 - - $
2:
3: #include <iostream>
4: #include <string>
5: #include <vector>
6: using namespace std;
7:
8: #include <libgen.h>
9: #include <sys/types.h>
10: #include <unistd.h>
11:
12: #include "cix_protocol.h"
13: #include "logstream.h"
14: #include "signal_action.h"
15: #include "sockets.h"
16:
17: logstream log (cout);
18:
19: void fork_cixserver (server_socket& server, accepted_socket& accept) {
20:     pid_t pid = fork();
21:     if (pid == 0) { // child
22:         server.close();
23:         string sock_fd = accept.to_string_socket_fd();
24:         log << "execlp cixserver (fd" << sock_fd << ")" << endl;
25:         execlp ("cix-server", "cix-server", sock_fd.c_str(), nullptr);
26:         // Can't get here?!
27:         log << "execlp failed: " << strerror (errno) << endl;
28:         throw cix_exit();
29:     }else {
30:         accept.close();
31:         if (pid < 0) {
32:             log << "fork failed: " << strerror (errno) << endl;
33:         }else {
34:             log << "forked cixserver pid " << pid << endl;
35:         }
36:     }
37: }
38:
39: void reap_zombies() {
40:     for (;;) {
41:         int status;
42:         pid_t child = waitpid (-1, &status, WNOHANG);
43:         if (child <= 0) break;
44:         log << "child " << child
45:             << " exit " << (status >> 8)
46:             << " signal " << (status & 0x7F)
47:             << " core " << (status >> 7 & 1) << endl;
48:     }
49: }
50:
```

```
51:
52:
53: void signal_handler (int signal) {
54:     log << "signal_handler: caught " << strsignal (signal) << endl;
55:     reap_zombies();
56:     switch (signal) {
57:         case SIGINT: case SIGTERM: throw cix_exit();
58:         default: break;
59:     }
60: }
61:
62: int main (int argc, char** argv) {
63:     log.set_execname (basename (argv[0]));
64:     log << "starting" << endl;
65:     vector<string> args (&argv[1], &argv[argc]);
66:     signal_action (SIGCHLD, signal_handler);
67:     signal_action (SIGINT, signal_handler);
68:     signal_action (SIGTERM, signal_handler);
69:     in_port_t port = get_cix_server_port (args, 0);
70:     try {
71:         server_socket listener (port);
72:         for (;;) {
73:             log << to_string (hostinfo()) << " accepting port "
74:             << to_string (port) << endl;
75:             accepted_socket client_sock;
76:             for (;;) {
77:                 try {
78:                     listener.accept (client_sock);
79:                     break;
80:                 }catch (socket_sys_error& error) {
81:                     switch (error.sys_errno) {
82:                         case EINTR:
83:                             log << "listener.accept caught "
84:                             << strerror (EINTR) << endl;
85:                             break;
86:                         default:
87:                             throw;
88:                     }
89:                 }
90:             }
91:             log << "accepted " << to_string (client_sock) << endl;
92:             try {
93:                 fork_cixserver (listener, client_sock);
94:                 reap_zombies();
95:             }catch (socket_error& error) {
96:                 log << error.what() << endl;
97:             }
98:         }
99:     }catch (socket_error& error) {
100:         log << error.what() << endl;
101:     }catch (cix_exit& error) {
102:         log << "caught cix_exit" << endl;
103:     }
104:     log << "finishing" << endl;
105:     return 0;
106: }
107:
```



```
1: // $Id: cix-client.cpp,v 1.3 2014-05-27 17:16:42-07 - - $
2:
3: #include <iostream>
4: #include <string>
5: #include <vector>
6: #include <unordered_map>
7: using namespace std;
8:
9: #include <libgen.h>
10: #include <sys/types.h>
11: #include <unistd.h>
12:
13: #include "cix_protocol.h"
14: #include "logstream.h"
15: #include "signal_action.h"
16: #include "sockets.h"
17:
18: logstream log (cout);
19:
20: unordered_map<string,cix_command> command_map {
21:     {"exit", CIX_EXIT},
22:     {"help", CIX_HELP},
23:     {"ls" , CIX_LS },
24: };
25:
26: void cix_help() {
27:     static vector<string> help = {
28:         "exit          - Exit the program.  Equivalent to EOF.",
29:         "get filename - Copy remote file to local host.",
30:         "help           - Print help summary.",
31:         "ls             - List names of files on remote server.",
32:         "put filename - Copy local file to remote host.",
33:         "rm filename  - Remove file from remote server.",
34:     };
35:     for (const auto& line: help) cout << line << endl;
36: }
37:
38: void cix_ls (client_socket& server) {
39:     cix_header header;
40:     header.cix_command = CIX_LS;
41:     log << "sending header " << header << endl;
42:     send_packet (server, &header, sizeof header);
43:     recv_packet (server, &header, sizeof header);
44:     log << "received header " << header << endl;
45:     if (header.cix_command != CIX_LSOUT) {
46:         log << "sent CIX_LS, server did not return CIX_LSOUT" << endl;
47:         log << "server returned " << header << endl;
48:     }else {
49:         char buffer[header.cix_nbytes + 1];
50:         recv_packet (server, buffer, header.cix_nbytes);
51:         log << "received " << header.cix_nbytes << " bytes" << endl;
52:         buffer[header.cix_nbytes] = '\0';
53:         cout << buffer;
54:     }
55: }
56:
```

```
57:
58: void usage() {
59:     cerr << "Usage: " << log.execname() << " [host] [port]" << endl;
60:     throw cix_exit();
61: }
62:
63: void signal_handler (int signal) {
64:     log << "signal_handler: caught " << strsignal (signal) << endl;
65:     switch (signal) {
66:         case SIGINT: case SIGTERM: throw cix_exit();
67:         default: break;
68:     }
69: }
70:
71: int main (int argc, char** argv) {
72:     log.set_execname (basename (argv[0]));
73:     log << "starting" << endl;
74:     vector<string> args (&argv[1], &argv[argc]);
75:     signal_action (SIGINT, signal_handler);
76:     signal_action (SIGTERM, signal_handler);
77:     if (args.size() > 2) usage();
78:     string host = get_cix_server_host (args, 0);
79:     in_port_t port = get_cix_server_port (args, 1);
80:     log << to_string (hostinfo()) << endl;
81:     try {
82:         log << "connecting to " << host << " port " << port << endl;
83:         client_socket server (host, port);
84:         log << "connected to " << to_string (server) << endl;
85:         for (;;) {
86:             string line;
87:             getline (cin, line);
88:             if (cin.eof()) throw cix_exit();
89:             log << "command " << line << endl;
90:             const auto& itor = command_map.find (line);
91:             cix_command cmd = itor == command_map.end()
92:                 ? CIX_ERROR : itor->second;
93:             switch (cmd) {
94:                 case CIX_EXIT:
95:                     throw cix_exit();
96:                     break;
97:                 case CIX_HELP:
98:                     cix_help();
99:                     break;
100:                 case CIX_LS:
101:                     cix_ls (server);
102:                     break;
103:                 default:
104:                     log << line << ": invalid command" << endl;
105:                     break;
106:             }
107:         }
108:     } catch (socket_error& error) {
109:         log << error.what() << endl;
110:     } catch (cix_exit& error) {
111:         log << "caught cix_exit" << endl;
112:     }
113:     log << "finishing" << endl;
114:     return 0;
```

**05/27/14**  
**17:16:44**

\$cmpps109-wm/Assignments/asg5-client-server/code/  
cix-client.cpp

**3/3**

```
115: }  
116:
```

```
1: // $Id: cix-server.cpp,v 1.2 2014-05-27 17:16:42-07 - - $
2:
3: #include <iostream>
4: using namespace std;
5:
6: #include <libgen.h>
7:
8: #include "cix_protocol.h"
9: #include "logstream.h"
10: #include "signal_action.h"
11: #include "sockets.h"
12:
13: logstream log (cout);
14:
15: void reply_ls (accepted_socket& client_sock, cix_header& header) {
16:     FILE* ls_pipe = popen ("ls -l", "r");
17:     if (ls_pipe == NULL) {
18:         log << "ls -l: popen failed: " << strerror (errno) << endl;
19:         header.cix_command = CIX_NAK;
20:         header.cix_nbytes = errno;
21:         send_packet (client_sock, &header, sizeof header);
22:     }
23:     string ls_output;
24:     char buffer[0x1000];
25:     for (;;) {
26:         char* rc = fgets (buffer, sizeof buffer, ls_pipe);
27:         if (rc == nullptr) break;
28:         ls_output.append (buffer);
29:     }
30:     header.cix_command = CIX_LSOUT;
31:     header.cix_nbytes = ls_output.size();
32:     memset (header.cix_filename, 0, CIX_FILENAME_SIZE);
33:     log << "sending header " << header << endl;
34:     send_packet (client_sock, &header, sizeof header);
35:     send_packet (client_sock, ls_output.c_str(), ls_output.size());
36:     log << "sent " << ls_output.size() << " bytes" << endl;
37: }
38:
```

```
39:
40: void signal_handler (int signal) {
41:     log << "signal_handler: caught " << strsignal (signal) << endl;
42:     switch (signal) {
43:         case SIGINT: case SIGTERM: throw cix_exit();
44:         default: break;
45:     }
46: }
47:
48: int main (int argc, char**argv) {
49:     log.set_execname (basename (argv[0]));
50:     log << "starting" << endl;
51:     vector<string> args (&argv[1], &argv[argc]);
52:     signal_action (SIGINT, signal_handler);
53:     signal_action (SIGTERM, signal_handler);
54:     int client_fd = stoi (args[0]);
55:     log << "starting client_fd " << client_fd << endl;
56:     try {
57:         accepted_socket client_sock (client_fd);
58:         log << "connected to " << to_string (client_sock) << endl;
59:         for (;;) {
60:             cix_header header;
61:             recv_packet (client_sock, &header, sizeof header);
62:             log << "received header " << header << endl;
63:             switch (header.cix_command) {
64:                 case CIX_LS:
65:                     reply_ls (client_sock, header);
66:                     break;
67:                 default:
68:                     log << "invalid header from client" << endl;
69:                     log << "cix_nbytes = " << header.cix_nbytes << endl;
70:                     log << "cix_command = " << header.cix_command << endl;
71:                     log << "cix_filename = " << header.cix_filename << endl;
72:                     break;
73:             }
74:         }
75:     } catch (socket_error& error) {
76:         log << error.what() << endl;
77:     } catch (cix_exit& error) {
78:         log << "caught cix_exit" << endl;
79:     }
80:     log << "finishing" << endl;
81:     return 0;
82: }
83:
```

```
1: # $Id: Makefile,v 1.5 2014-05-27 15:55:33-07 - - $
2:
3: GPP          = g++ -g -O0 -Wall -Wextra -std=gnu++11
4:
5: DEFILE       = Makefile.dep
6: HEADERS      = sockets.h signal_action.h cix_protocol.h logstream.h
7: CPPLIBS      = sockets.cpp signal_action.cpp cix_protocol.cpp
8: CPPSRCS      = ${CPPLIBS} cix-daemon.cpp cix-client.cpp cix-server.cpp
9: LIBOBS       = ${CPPLIBS:.cpp=.o}
10: CLIENTOBS    = cix-client.o ${LIBOBS}
11: SERVEROBS    = cix-server.o ${LIBOBS}
12: DAEMONOBS    = cix-daemon.o ${LIBOBS}
13: OBJECTS      = ${CLIENTOBS} ${SERVEROBS} ${DAEMONOBS}
14: EXECBINS     = cix-client cix-server cix-daemon
15: LISTING      = Listing.ps
16: SOURCES      = ${HEADERS} ${CPPSRCS} Makefile
17:
18: all: ${DEFILE} ${EXECBINS}
19:
20: cix-client: ${CLIENTOBS}
21:          ${GPP} -o $@ ${CLIENTOBS}
22:
23: cix-server: ${SERVEROBS}
24:          ${GPP} -o $@ ${SERVEROBS}
25:
26: cix-daemon: ${DAEMONOBS}
27:          ${GPP} -o $@ ${DAEMONOBS}
28:
29: %.o: %.cpp
30:          ${GPP} -c $<
31:
32: ci:
33:          - checksource ${SOURCES}
34:          - cid + ${SOURCES}
35:
36: lis: all ${SOURCES} ${DEFILE}
37:          mkpspdf ${LISTING} ${SOURCES} ${DEFILE}
38:
39: clean:
40:          - rm ${LISTING} ${LISTING:.ps=.pdf} ${OBJECTS}
41:
42: spotless: clean
43:          - rm ${EXECBINS}
44:
45: dep:
46:          - rm ${DEFILE}
47:          make --no-print-directory ${DEFILE}
48:
49: ${DEFILE}:
50:          ${GPP} -MM ${CPPSRCS} >${DEFILE}
51:
52: again: ${SOURCES}
53:          make --no-print-directory spotless ci all lis
54:
55: include ${DEFILE}
56:
```

```
1: sockets.o: sockets.cpp sockets.h
2: cix_protocol.o: cix_protocol.cpp cix_protocol.h sockets.h
3: cixdaemon.o: cixdaemon.cpp logstream.h sockets.h
4: cixclient.o: cixclient.cpp logstream.h sockets.h cix_protocol.h
```