

**ixemul.info**

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# Chapter 1

## ixemul.info

### 1.1 IXemul.library

```
IXemul.library
*****
```

Introduction	Why IXemul.library?
Installation	How to Install it
Copyright	Copyright Restrictions
GNU License	The GNU General Public License
Authors	The Authors of IXemul.library
Configuring	Configuring IXemul.library to your tastes
Tracing	Tracing Your Programs with IXemul.trace
Recompiling	Recompiling IXemul.library
Porting UNIX Apps	Porting UNIX Applications
IXemul's Signals	Implementation of BSD Signals
Bugs	Where to Report Bugs or Suggestions
FAQ's	Frequently Asked Questions

### 1.2 IXemul.library/Introduction

Why IXemul.library?

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IXemul.library was originally written to provide an environment for the porting and subsequent compilation of UNIX C programs. The design of the library was therefore guided towards UNIX/BSD compatibility, and *\*not\**:

- o To be too conservative with resources.
- o To be particularly conformant to Amiga habits. Thus if I had to decide whether I should make a function act more like an Amiga function or more like a UNIX/BSD one, I decided for the latter. As an example: `_cli_parse()` does wildcard expansion, and tries to apply more or less UNIX/BSD shell semantics to an argument line, it doesn't call `ReadArgs()`.

The types used in my own source code are all from `sys/types.h` (except `BPTR`). I don't think capitalized identifiers should be used for typedef'd types. According to C-conventions, anything written in captials should be '#undef'inable, which typedefs aren't. Thus if you write contributions to be included into the official distribution of this library, code according to this. Use '`u_char`' and not `UBYTE`, etc. I don't care that this is against the Commodore coding standard, this is my code, and I decide what I like and what not.

- o To be particularly suited for inclusion into a shared library, although most things *are* shared now. What I'd really want for the Amiga is the concept of a dynamic linker.

On the other hand, it is:

- o Expandable. As an example, a file descriptor already can refer to 'real' files, directories, memory buffers treated as files.
- o Patchable. If you want some function to behave differently, you can `SetFunction()` it, and the rest of the library should use your new entry.

### 1.3 IXemul.library/Installing IXemul.library

Installing IXemul.library on your system

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In the `libs` directory of this release are 4 versions of IXemul.library:

- 1) IXemul.library.000
- 2) IXemul.library.020noffp
- 3) IXemul.library.020ffp
- 4) IXemul.library.030

There is also a special version of IXemul.library called `ixemul.trace`. More on this later.

If you have a 68000 or 68010: Rename IXemul.library.000 as IXemul.library and place it in your `libs:` directory.

If you have a 68020 or a 68030 and NO math coprocessor: Rename IXemul.library.020noffp as IXemul.library and place it in your `libs:` directory.

If you have a 68020 and a 68881 or 68882: Rename IXemul.library.020ffp as IXemul.library and place it in your `libs:` directory.

If you have a 68030 (and a 68881 or 68882) or a 68040: Rename IXemul.library.030 as IXemul.library and place it in your `libs:` directory.

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Next, copy the files in `lib` to `gcc:lib` and the files in `lib/libb` to `gcc:lib/libb`.

If you have a 68020 or higher, also copy the files in lib/lib020 to gcc:lib/lib020 and the files in lib/lib020/libb to gcc:lib/lib020/libb.

Copy the include files to their respective places in gcc:include.

IXemul.trace provides a means of tracing the library calls made by your program and printing them in a CLI window. Just copy this file into your libs: directory for now. See IXemul.trace for more details.

## 1.4 IXemul.library/Copyright

### Copyright Restrictions

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Since both I and Markus Wild declare the glue functions created by compiling and running gen\_glue.c (in lib/) to be in the Public Domain (thus not to be covered by any license), your compiled and linked executable will NOT become a derivative of the library, and will thus not be subject to this license. Thus, you may use the compiled version of the glue files and the stdio functions, libc.a (except alloca.c, please see the copyright notice in its header. Use the builtin alloca() (\_\_builtin\_alloca() to be explicit) in all situations where this is possible) and crt0.o in a commercial product without making it a derivative of the library and thus make it subject to the library license. However, you must tell your customers that ixemul.library is free software according to this license, and where they can get a copy of its source code.

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## 1.5 IXemul.library/Authors

Authors

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Also, some of the code in the library is taken from other software under the GNU General Public License and is thus governed by their restrictions as well. See Copyright for the restrictions.

The original version of ixemul.library was written by Markus Wild. He now presently works on NetBSD, a UNIX port for the Amiga. For those interested in running a Public Domain UNIX, you can get the necessary files ftp from: ftp.iastate.edu or from sun-lamp.cs.berkeley.edu.

This version was built and updated by Rafael Luebbert. He can be reached VIA E-mail at LuebbeRW@lp.musc.edu.

The following people have contributed files to be included in the IXemul.library:

Leonard Norgaard  
Ray Burr

Also, thanks to all beta-testers and everyone who reported bugs in previous releases.

## 1.6 IXemul.library/Configuring IXemul.library

Configuring IXemul.library to your tastes

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Ixconfig is used to tailor the library to your requirements and/or habits. Just running ixconfig without options prints the current settings, which look like this by default:

```
1> ixconfig
Translate . and .., translate /, don't translate symlinks,
allow AmigaDOS notation, membuf size = 0,
red zone size = 0, stack watcher is disabled (and not active).
```

Here's an explanation of those settings:

"translate . and .." mapping of 'a/./b/./c' into 'a/b/c' is enabled  
"translate /" mapping of 'a///b' into 'a/b' and '/device' into  
'device:' is enabled. Note: You can't currently get  
a directory of the virtual '/' directory this way.

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"translate symlinks" apply 'translate //' to contents of symlinks as well

"AmigaDOS notation" allow use of device names in the colon form  
(ie. sys: instead of /sys), and don't force '..' notation.

"membuf size" if you set a non-zero value here, all files upto that value, that are opened O\_RDONLY are read into memory, and read/seek operations occur in memory.

"red zone size N" size of 'safety net'. If your program uses so much stack, that the stack pointer is more than N bytes near the stack bottom, your program is sent a SIGSEGV signal. Red zone size is used when starting a new process, if you change it later, no already running processes are affected.

"stack watcher" global toggle. If disabled, no SIGSEGV signal is sent to any program (but if red zone size is > 0, the process keeps a pointer, so that if you reenale the stack watcher, SIGSEGV will be sent again).

This was an explanation of the output of ixconfig, to change those values type 'ixconfig -h' for an explanation on the available switches. One switch might need further explanation: '-s'. If you specify '-s', ixconfig goes to sleep after setting the new parameters, and won't return until you break it with ^C. This is the preferred switch if you run ixconfig from your startup-sequence in the background, as then your changes can't be undone by flushing the library (ixconfig keeps it open, so that Expunge() can't flush it).

## 1.7 IXemul.library/GNU License

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Version 2, June 1991

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[This is the first released version of the library GPL. It is  
numbered 2 because it goes with version 2 of the ordinary GPL.]

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However, unrestricted linking of non-free programs would deprive the

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If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

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Also add information on how to contact you by electronic and paper mail.

You should also get your employer (if you work as a programmer) or your school, if any, to sign a "copyright disclaimer" for the library, if necessary. Here is a sample; alter the names:

Yoyodyne, Inc., hereby disclaims all copyright interest in the library 'Frob' (a library for tweaking knobs) written by James Random Hacker.

<signature of Ty Coon>, 1 April 1990  
Ty Coon, President of Vice

That's all there is to it!

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## 1.8 IXemul.library/IXemul.trace

### Tracing Your Program Using IXemul.trace

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This is an attempt at a tracer for ixemul.library. Since it scans every call made thru the library base, it catches even more calls than for example SnoopDOS.

Since tracing support slows down *all* clients of the library (as each call is now routed thru tracing functions), there are two library versions. ixemul.library itself doesn't contain tracing support, using the tracer with this library gives you a "Function not implemented" error. To use the tracer you have to load ixemul.trace as the main library. See below for more detailed instructions.

The tracer itself is quite straight forward, a lot more calls could use more descriptive parameters, its mostly typing work, but I didn't feel like providing more ioctl, open, pipe like print functions ;-))

The option you're most certainly going to use is '-m', as the library uses sigsetmask() internally a lot, and its mentioning would just clutter the overwhole display.

### Short instructions to get the tracer up

-----

- o Flush ixemul.library out of the system. I use "avail flush". If you are using ixconfig to keep the library loaded so your defaults don't get changed, you'll have to reboot.
- o Make sure the system loads ixemul.trace instead of ixemul.library next time it tries to fire up ixemul.library. I usually do this by renaming IXemul.library to IXemul.lib, and then renaming IXemul.trace to ixemul.library. **DON'T FORGET TO SWITCH BACK LATER!**
- o Start the tracer (in bin:trace). The following options are currently recognized (see bin:trace.c as well):
  - a print all calls, even those considered 'not interesting', for example internal stdio calls, 32bit arithmetic emulation for 68000, and such stuff you generally don't want to see.
  - i normally, the tracer shows a function call when that function returns, to be able to display the return value (and 'errno' in parenthesis). When you specify '-i', it always displays function on entry, instead of on exit. See below for current problems without the -i option!
  - m skip sigsetmask calls. This function is used extensively inside the library, and will in most cases just clutter the tracer output with information you don't want to see.
  - o specify a logfile. If -o is omitted, output goes to stdout.
  - p only print output from a specific process. You have to provide the decimal address of the process (ok ok, this is not too user-friendly,

I'm open to better alternatives ;-)). Default is to scan all current ixemul clients.

-s only print calls to specific system call. You have to specify the number as found in <sys/syscalls.def>. Again, this option could be much more user-friendly, but I'm a lazy guy;-)

You should now see a log of all functions involved from your program(s), and some functions involved as a consequence of your functions from inside the library. The output means:

```
$7588790: <strcmp("foo", "-n")=57 (0)
^      ^      ^      ^      ^
|      |      |      |      |
|      |      |      |      | errno value
|      |      |      |      | result of function
|      |      |      |      |
|      |      |      |      | parameters
|      |      |      |      |
|      |      |      |      | type of log, < means exit, > means entry
process address
```

#### Some known problems

-----

There seems to be some race condition, that can result in deadlock when running without the -i flag. I don't know, where the problem lies, such stuff is really hard to find...

Currently, if trace-on-exit is enabled, the function is called with 16 arguments, no matter how many arguments you passed to it. This should be enough for 99% of all applications, but you may have more than 16 arguments to a printf() somewhere.

Functions returning more than a 4byte result \*don't\* work unless you specify the -i option!!

## 1.9 IXemul.library/Recompiling IXemul.library

### Recompiling IXemul.library

First, you'll need RCS, or a port of it. I use HWGRCS which is wonderful. You'll also need to get bsd-ld, which supports reloc-sizes that ld does not.

Sources are written for compilation by GCC. You might be able to compile 95% of them with any ordinary ANSI-C compiler, but there are cases where you have to change things for non-GCC environments (mostly asm() situations).

To regenerate the library, cd to ixem40.3/ and type allclean. This is a batch file that will clean any older version objects you have in the subdirectories. Then choose the allmake file appropriate to your hardware and type "allmake" then go make a sandwich and watch some television - it will take some time.

For 68000 users, you'll have to find GNU's gas 1.36 as gas 2.3 incorrectly parses aligns in some assembly. You will also have to

recompile some files and assemble them with gas 1.36. See the file "readme.68000.recompile" for more details on which files.

To regenerate libc.a, cd into ixem40.3/ and type 'libcmake'. Wait for it to finish (can take quite some time, it has to create more than 400 files !).

As an explanation to the separate compilation of crt0.o: this has to be compiled with '-fwritable-strings', since you have to be sure that ENTRY() is the first thing in the generated object file. If you don't specify '-fwritable-strings', you'll get string constants at the first executable address in your programs, and this will get you (and your computer) into meditation if you try to execute such programs ;-))

## 1.10 IXemul.library/Signals in IXemul.library

How BSD signals are implemented  
\*\*\*\*\*

I tried to implement as much of Berkeley style signals as possible on the Amiga. This includes a trap handler as well as an asynchronous signal facility. The one thing not implemented are interruptable system calls. Since there are no 'real' system calls on the Amiga (ie. no calls that are executed in Supervisor mode), those calls cannot normally be interrupted, ie. forced to return to their caller. So all functions except sigpause()/sigsuspend() will return to where they were interrupted if a signal occurs.

These 32 new signals are 32 really new signals, not tied to any of the 32 Amiga signals provided by Exec. The one exception is SIGBREAKB\_CTRL\_C, which is by default bound to generate a SIGINT.

Signal handlers are called with the following arguments:

```
void
signal_handler (int signo, int code, void *address, struct sigcontext *sc)
```

Where

```
signo:  is the signal number that occurred, see <signal.h>
code:   is a more specific characterization of signo available with some
        signals. It is available with all signals that are generated
        because of a processor exception, and then contains the format
        identifier of the exception frame (this is correct even for the
        68000, where such an identifier is faked, ie. it doesn't really
        exist). Thus a 'division by zero' exception would be invoked by
        signal_handler (SIGFPE, 0x2014, address, sc)
address: address refers to the instruction that caused the signal.
sc:      please don't use sc, as it may change in the future. It contains
        the context to restore after the signal handler returns.
```

\*\*\*\*\*  
If you use signals in your own code, make sure that you never allow a situation, where when your program is interrupted resources stay allocated!  
\*\*\*\*\*

That is, the following example is BAD :

```
..
fh = Open ("foobar", MODE_OLDFILE);
if (fh)
{
    .. do something with it ..
    Close (fh);
}
```

If your program is interrupted and terminated after you got your file handle, 'fh' will never be closed! There are two solutions to get around this problem, either use library functions from ixemul.library, or explicitly mask signals while you have resources locked. Thus in this example, either do:

```
fd = open ("foobar", O_RDWR);
if (fd >= 0)
{
    .. do something with it ..
    close (fd);
}
```

in that case the library will do resource tracking on fd. Or explicitly mask the signals:

```
omask = sigsetmask (~0); /* mask all signals */
fh = Open ("foobar", MODE_OLDFILE);
if (fh)
{
    .. do something with it ..
    Close (fh);
}
sigsetmask (omask); /* reset the mask */
```

Note that the second solution is worse than the first one, because the user may send the process a non-maskable signal that would terminate the process unconditionally (SIGKILL does this), and don't forget that the user isn't able to break your program as long as you have signals masked!

Ixemul.library does resource tracking on all file-related functions (create(), open(), dup(), pipe()) and on memory allocations thru malloc() and realloc(). Thus if you use those functions instead of dos.library and exec.library functions, you don't need any clever resource tracking stuff to do on your own, that's what the library is for ;-)

If you use Amiga specific resources like Windows and Screens from Intuition, make sure to add an atexit() handler to close those resources, if the user should decide to interrupt your program. Before the program is left, the chain of registered atexit-handlers is called in exit(). So PLEASE NEVER EVER call \_exit() if you have registered any custom atexit() handlers. It is a bad habit anyway, but normally you may call \_exit() without resource loss (stdio won't flush its buffers, but that's about all), as long as you close ixemul.library after use, and this IS A MUST, as for every Amiga shared library anyway.

I provided a new unique Amiga specific signal called SIGMSG. If you set up a handler for this signal, then

- o the default mapping from SIGBREAKB\_CTRL\_C into SIGINT will no longer

occur

- o your handler is called with the following arguments  
     signal\_handler (SIGMSG, new\_exec\_signal\_mask)

In this case, you have to deal with Exec signals yourself, so don't forget to clear those signals that you want to receive notification about again later.

Thus if you'd want to handle SIGBREAKB\_CTRL\_C yourself, don't forget to

```
SetSignal (0, SIGBREAKF_CTRL_C)
```

at the end of the handler, or you'll never get notification about that signal again.

If your program is interrupted by a signal and the default action of that signal is to terminate your program, and you didn't set up a handler to deal with that signal, your program is terminated by calling 'exit (128 + signo)'. There are no core-dumps yet, I first have to think about a useful format for a debugger that takes care of the Amiga's memory architecture.

The signal implementation uses some of the Berkeley kernel sources of the 4.3BSD-reno release for the hp300. I didn't disable everything that isn't implemented currently, so you might face strange behavior if you currently try to send a SIGSTOP to a process using the library, you better not ;-) )

Currently supported are the following signals:

```
SIGINT:    bound to ^C (SIGBREAKB_CTRL_C) unless there is a SIGMSG handler
SIGILL:    generated by some hardware exceptions
SIGFPE:    generated by some hardware exceptions
SIGBUS:    generated by some hardware exceptions
SIGALRM:   if you use alarm() or the ITIMER_REAL interval timer
SIGVTALRM: if you use the ITIMER_VIRTUAL interval timer
SIGPROF:   if you use the ITIMER_PROF interval timer
SIGMSG:    if you provide a signal handler for it
SIGCHLD:   a vfork()'d child died (or stopped ?;-))
SIGSEGV:   the programs used more stack than you allowed it to (see below)
```

more are to follow. You may send any of the 32 signals to a process using the library with the 'kill ()' function, the default behavior of a process is described in a UNIX/BSD man page for signals. As mentioned above, stopping a process isn't currently implemented, and may produce strange behavior.

## 1.11 IXemul.library/Porting Unix Applications

Porting UNIX Applications

\*\*\*\*\*

Several functions are missing from IXemul.library, mainly those that depend on UNIX's unique memory handling. sbrk and brk are old archaic functions that should be replaced in any new ports of UNIX applications anyway.

UNIX/BSD process management is one of the most nasty design differences between AmigaDOS and UNIX/BSD. `'fork()'` for example is hardly possible to implement on AmigaDOS, as it requires to create an identical copy of the parent process. This is only feasible with virtual memory, where processes can be mapped at equal places in memory. Under AmigaDOS this would have to be simulated by copying of stack and malloc'd data whenever a process is activated, and copying them to a safe place before it is disactivated.

This problem can be avoided, if the program to be run under AmigaDOS is only `fork()`ing, because it just wants to start another process. In that case, no such copying as described before is necessary, and BSD therefore invented the `'vfork()'` function, which works like `'fork'`, but runs the child on the parents memory segments (stack and malloc'd data). While the child is using the parents resources, the parent is sleeping in a not interruptible state.

That much for theory;-) I tried to implement an as compatible as possible `vfork()` function, that behaves like the BSD one.

Since I won't try to implement `'fork'`, I provided a possible alternative (you tell me;-)). As an extension, you get the `'vfork_resume()'` function, which causes the parent to resume, just like it would if you called `'_exit()'` or one of the `'exec*()'` functions. Since this function is quite dangerous (and an even bigger hack than `vfork()` itself..), here's what's happening in `'vfork_resume()'`:

- o the child switches to its own stack. After `vfork()`, the child is using the stack of the parent process. Since no two processes can share the same stack in parallel, `vfork_resume()` causes a switch to the `'real'` stack of the child.
- o the parent is sent a wakeup message.
- o both processes run concurrently

The first point is the most important one: Since `vfork_resume()` changes the stack pointer of the running process, you can't refer to any variables or parameters anymore after calling `vfork_resume()`! Only register variables survive such a call, and you have to explicitly store values in register variables that are subject to survive!

There's another potential problem with `vfork_resume()`:

```
*****
Don't exit() from the parent before all vfork()'d children have died!!
*****
```

Since exiting from the parent causes the parents code and data segments to be deallocated, the child would find itself without code space to run on, and would probably cause a severe machine crash!

So always call at least `'wait (0)'` before returning from the parent.

```
exec*()
=====
```

In most cases, you just use `'vfork()'` to later overlay the process with a new image, that is you want to start another program. The way AmigaDOS loads processes is not too well suited to do `'exec'` style program starting, yet it is possible, although with slight resource wasting..

First problem is, that all `exec*` functions pass an argument vector to the new program, whereas AmigaDOS programs expect to be passed an argument line (instead of the vector of arguments). Since in my opinion it would be a good thing if a program could get an argument vector directly (in that case the inherent problem of passing multi word arguments to a program would be finally solved, no more weird quoting needed!). That's why I provided a mechanism that allows this vector passing, and it works like this (look at `crt0.c` for a concrete implementation of this concept!):

The program has to provide a magic header at the first executable location in its code. This magic header looks like this:

- o JMP instruction to common AmigaDOS startup
- o struct `exec` area. Use the OMAGIC `a_magic` code.
- o provide an alternate entry vector in `a_entry`. `execve()` jumps thru this vector to pass vectors to your program, instead of going thru the normal AmigaDOS startup part.

As long as you use my `crt0.o` and `libc.a`, this whole thing is completely transparent to your program. You only have to care for it if you want to support the mechanism in other languages as well.

The second problem is how to start 'old' AmigaDOS programs from `execve()`. If the program has the described magic header, starting is easy. Else another approach is taken. Since the new program can't refer to the real file descriptors (I can't pass the open library without my startup code), I have to setup DOS fields to use my filehandles. This may succeed or not, depending on whether the descriptors in question are realized by DOS files or not (in the future a not-compatible alternative would be descriptors that refer to sockets!). Actual starting of the program is done with `RunCommand()`.

## 1.12 IXemul.library/Where to Send Bug Reports and Suggestions

Where to Send Bug Reports and/or Improvements in Code

\*\*\*\*\*

If discover any bugs in `ixemul.library`, please send me e-mail with the following information:

- 1) Your hardware configuration.
- 2) The version of `ixemul.library` you are using.
- 3) The function called when the crash occurred (using `ixemul.trace`)

If you have any suggestions or improvement in the code, please send them to me so they can be included in the next version.

My E-Mail address is: `LuebberRW@lp.musc.edu`

I also read posts made to `amiga-gcc-port@lists.funet.fi`

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## 1.13 IXemul.library/Frequently Asked Questions

### Frequently Asked Questions

\*\*\*\*\*

1) How can I inline IXemul.library's functions like the Amiga's functions?

You can't. The library is designed to be used by C, and not by assembly. So parameters are passed on the stack rather than in registers. This also means that there is no 'fd' file, and you can't use any current library call pragmas to access its functions. Recall though, that calling functions of ixemul.library inline will not result in an order of improvement as calling standard library functions inline. The glue functions don't have to shuffle arguments from and to the stack, they just do a jump over the base table and are therefore very short and very fast.

2) Can't you take out that damn trap handler so I can trace my programs?

I plan on releasing a patch to disable the trap handler. In the meantime, you can use ixemul.trace, and you can use PowerVisor 1.42 with the dirty mode enabled.