Simple Calls for Flexible Constructs Using the Traditional File API

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Simple calls for flexible constructs using the traditional file API∗∥

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Abstract

We present the design for a remote qos control interface to the transport protocol based on existing work for similar applications. This puts together the read/write calls from the traditional file system API and an additional primitive. The addition amounts to programming an operating system data-streaming service which may be provided as a system call or otherwise using the standard techniques. Put together these allow much more than the traditional call based control interface. The resulting interface simplifies the mechanisms for distributed control. Parts of this interface have also been implemented in our ongoing experiments with file transfer.

1 Introduction

In this note we make a case for simple kernel construct for transport control interface, based on closely similar implementations for a data transfers service on Unix. The use for this construct would be to remotely control protocols between machines that can establish authenticated connections. Using this design, it is possible to bypass the tradition user space based implementations.

The construct is simple, it uses Existing ideas, and one compatible extension. The extension can extend the interface very flexibly, as it is modular. The basic concept was implemented, in a very similar application, tested for control of file transfer.

2 Background

The traditional control interface for transport protocols on Unix uses the ioctl() system call (Described in the Unix online manual: man pages.). Examples of it’s use may be found in [4] [7]. If a system is to receive a control request from a remote system, the way to set this up would be to have a process wait for these requests, and make a local ioctl call based on the control request. This amounts to an remote procedure call like mechanism. These will have a response time dictated by the speed at which the process can be scheduled. While that is of some importance, in a multiprocessing system it cannot be avoided all together. What can be avoided is the scheduling

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of these requests entirely by user processes. If a number of connections are being serviced by a machine, a remote control would either entail user processes per connection or a centralized user space process for all these requests. It is possible to avoid this overhead and programming. It uses two key ideas. One is the use of the `write()` system call to send control information to the kernel. This is not a new idea, and has been in use \[3\] \[5\], and is also used in Plan 9 OS \[6\]. The second idea is to use a construct in the kernel, that can connect a remote socket to this write interface. This construct, is similar in functionality to \[1\] but differs in the implementation. Relevant to this description, the differences are in this implementation being at a higher level of abstraction, and the user interface being the abovementioned write call. Details of this construct and its evaluation are reported in \[2\].

3 Required extension

The basic service expected from the extension is to allow read/write to proceed in kernel with the standard kernel end-point abstraction, namely the file descriptor. The interface to this service is given to the user process as the same standard end-point (but a different descriptor) to write control information to this in-kernel read write service. Since the control interface to this read/write service is another descriptor, remote control entails simply invoking the same service twice, the second time with a socket connected to the remote machine and the control descriptor from this service. We validated this concept by a prototype implementation on Unix.

4 Why is this interface interesting?

There are several interesting features of this interface, other than streamlining the control path from a remote application. The invocation of the control path is per instance by the user process. It need not be be statically configured in the system afresh, for every new program as a RPC server or part of the program that polls requests from a remote machine. Since this concept is based on standard read/write, the concept is portable to other operating systems as well. Finally, since the kernel data transfer service returns a descriptor of the same type that it uses as it’s input parameter, the service is composable as a construct, i.e., the control interface can use the read write service again.

5 Example of Use

Following is an example of an implementation tested on Unix. Variables `ctl`, `s`, `d` are standard descriptors. Of these, `s` would be obtained by opening a source file, and `d` by a connecting to a remote machine via a socket.

```c
/* paraphrased */
ctl = readWriteService (s, d);
write (ctl, COMMANDS, T);
```

Here, `COMMANDS` is an array with requests from the service, and `T` is the size of the array, as usual in `write()`. These can be of an arbitrary length and type. The current implementation uses integers.

Alternatively, the commands can be sent from a remote machine, via a socket, say `r`:

```c
c12 = readWriteService (r, ctl);
```

Following this call, a remote machine can send control requests on socket `r` exactly as they would be written to it from the local machine.
6 Conclusion

We presented the design for a remote control interface for the transport protocols. The design is simple, as it uses familiar constructs and one compatible extension. The tests have been limited to a data transfer application. Additional security considerations may have to be taken into account while using this design for other protocols. In any case, this should not be considered any more secure than the socket that is used to send control information. Finally, for each controlled protocol, there will be a need to supply, or otherwise configure checks to ensure that a remote system command is not in error, or is not otherwise misinterpreted.

We have tested this concept for data transfer applications. Such a construct will allow streamlining distributed control.

References


