Realizing Concurrency using Posix Threads

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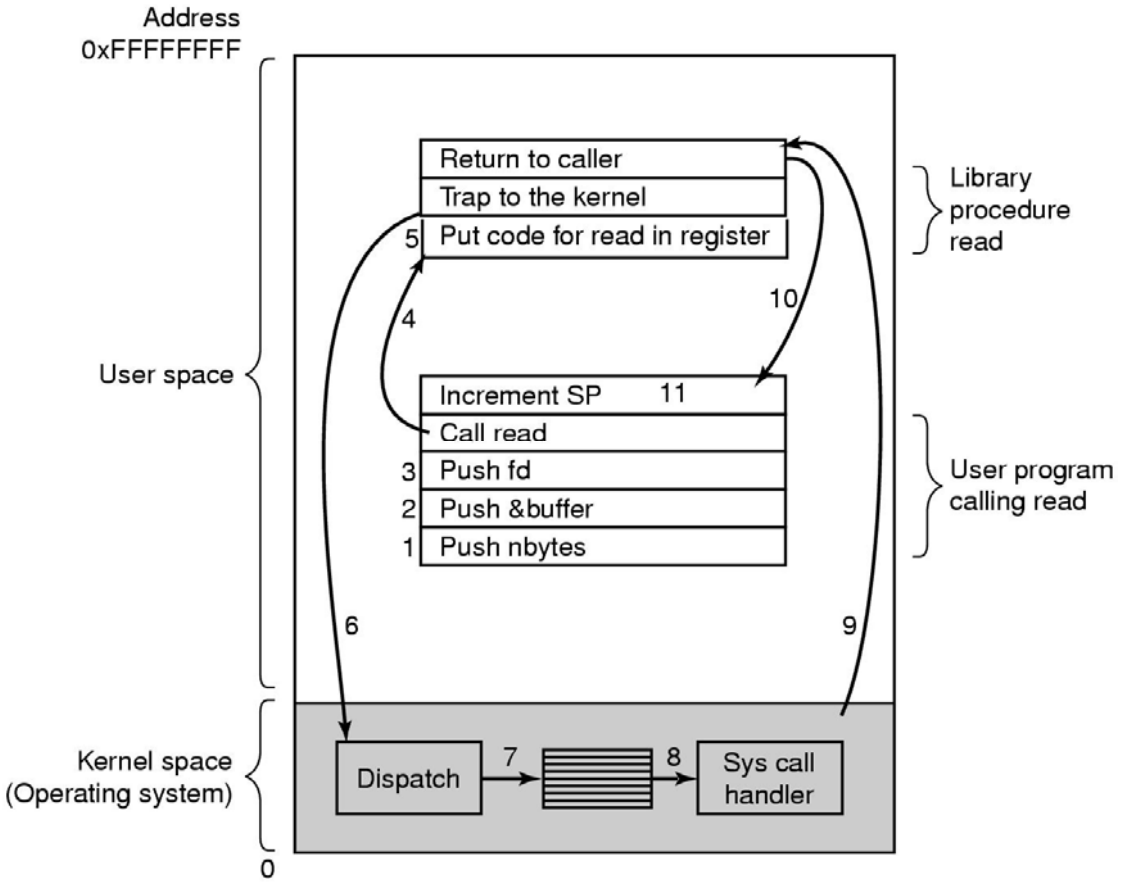
System Call



There are 11 steps in making the system call

read (fd, buffer, nbytes)

Some System Calls For Process Management and File Management

Process management

Call	Description
pid = fork( )	Create a child process identical to the parent
pid = waitpid(pid, &statloc, options)	Wait for a child to terminate
s = execve(name, argv, environp)	Replace a process' core image
exit(status)	Terminate process execution and return status

File management

Call	Description
fd = open(file, how, ...)	Open a file for reading, writing or both
s = close(fd)	Close an open file
n = read(fd, buffer, nbytes)	Read data from a file into a buffer
n = write(fd, buffer, nbytes)	Write data from a buffer into a file
position = lseek(fd, offset, whence)	Move the file pointer
s = stat(name, &buf)	Get a file's status information

Pipe IPC (Answer to Jason's Ques)

- Pipe allows for arbitrary sequences of commands to be coupled together.
- Syscall pipe returns two file descriptors: one for writing fd[1] to the pipe and another for reading fd[0] from the pipe.

```
int fd[2], retval;
retval = pipe(fd);
```

On to threads..

Introduction

- A **thread** refers to a thread of control flow: an independent sequence of execution of program code.
- Threads are powerful. As with most powerful tools, if they are not used appropriately thread programming may be inefficient.
- Thread programming has become viable solution for many problems with the advent of multiprocessors and client-server model of computing.
- Typically these problems are expected to handle many requests simultaneously. Example: multi-media, database applications, web applications.

Topics to be Covered

- Objective
- POSIX threads
- What are Threads?
- Creating threads
- Using threads
- Summary

Objective

- To study POSIX standard for threads called Pthreads.
- To study thread control primitives for creation, termination, join, synchronization, concurrency, and scheduling.
- To learn to design multi-threaded applications.

Threads

- A thread is a unit of work to a CPU. It is strand of control flow.
- A traditional UNIX process has a single thread that has sole possession of the process's memory and resources.
- Threads within a process are scheduled and execute independently.
- Many threads may share the same address space.
- Each thread has its own private attributes: stack, program counter and register context.

Creating threads

- Always include pthread library:

#include <pthread.h>

- int pthread_create (pthread_t *tp, const pthread_attr_t * attr, void *(* start_routine)(void *), void *arg);
- This creates a new thread of control that calls the function start_routine.
- It returns a zero if the creation is successful, and thread id in tp (first parameter).
- attr is to modify the attributes of the new thread. If it is NULL default attributes are used.
- The arg is passing arguments to the thread function.

Using threads

1. Declare a variable of type pthread_t
2. Define a function to be executed by the thread.
3. Create the thread using pthread_create

Make sure creation is successful by checking the return value.

4. Pass any arguments need through' arg (packing and unpacking arg list necessary.)
5. #include <pthread.h> at the top of your header.
6. Compile:

g++ -o executable file.cc -lthread

Thread's local data

- Variables declared within a thread (function) are called local data.
- Local (static) data associated with a thread are allocated on the stack. So these may be deallocated when a thread returns.
- So don't plan on using locally declared variables for returning arguments. Plan to pass the arguments thru argument list passed from the caller or initiator of the thread.

Thread termination (destruction)

Implicit : Simply returning from the function executed by the thread terminates the thread. In this case thread's completion status is set to the return value.

- Explicit : Use thread_exit.

Prototype: void thread_exit(void *status);

The single pointer value in status is available to the threads waiting for this thread.

Waiting for thread exit

- int pthread_join (pthread_t tid, void **statusp);
- A call to this function makes a thread wait for another thread whose thread id is specified by tid in the above prototype.
- When the thread specified by tid exits its completion status is stored and returned in statusp.