Name:_____ **SID:** _____

CSCE 351: Operating System Kernels

Lab 5 – "System Call" through OEMIoControl

Basic Setup:

- Windows 2000/XP workstation with Windows CE .Net 4.2 installed.

Prerequisite:

- Know how to create a new platform (covered in Lab 1) and know how to revise the kernel source code and rebuild the platform (covered in Lab 2)

Objectives:

The objectives of this lab are as follows:

- Familiarize students with calling system functions through *OEMIoControl* .
- Familiarize students with thread structure and kernel source code

Estimated Lab Time: 60 minutes

Introduction

The objective of this exercise is to familiarize students with the way of calling customized system functions throughOEMIoControl. System call is the interface between OS and the user level programs. Although Microsoft provides most of the kernel source code, they don't provide enough source code to creating a new system call. In this lab, we will study how to use *OEMIoControl* to create a "system call". We revise the source code of *OEMIoControl* implementation, where the system level functions are called. This works not exactly the same way as a system call. But, we are able to transfer user-level program to the system level. The method used in this lab may help you to debug your code in your final project.

Activity 1 Check if the library file are corrupted

Because we revised the source code in previous labs, the library files in some of the machines may be corrupted. Before we run this lab, we want to make sure the library files are fully functional. For the machines that have corrupted library files, we need to restore the library files. For each machine, we need to keep a backup for the library files.

1. Create a new platform with the following specification:
   - Platform name: *test_lastname_lab*
   - Use *c:\csce351_lab* for the path of your project.
   - In step 3 of the "New Platform Wizard" choose "Internet Appliance".
   - In step 4 choose only **Internet Explorer**.

- In step 5 choose the **default** setting.

2. Change from *Emulator:X86 Win32 (WCE Emulator) Release* to *Emulator:X86 Win32 (WCE Emulator) Debug*.
3. Build the platform
4. If the build succeeds, make a backup directory of the directory C:\WINCE500\PUBLIC\COMMON\OAK\LIB\X86\DEBUG in C:\WINCE500\PUBLIC\COMMON\OAK\LIB\X86\ and name the backup directory as DEBUG.backup
5. If the build fails, do the following step to restore the library files
   a. Remove the directory C:\WINCE500\PUBLIC\COMMON\OAK\LIB\X86\DEBUG
   b. Download the file rcf.unl.edu/~lshen/DEBUG.zip to C:\WINCE500\PUBLIC\COMMON\OAK\LIB\X86\
   c. Extract the DEBUG.zip by clicking right button and select "extract here…"
   d. make a backup directory of the directory C:\WINCE500\PUBLIC\COMMON\OAK\LIB\X86\DEBUG in C:\WINCE500\PUBLIC\COMMON\OAK\LIB\X86\ and name the backup directory as DEBUG.backup

Activity 2

1. Make a backup file for C:\WINCE420\PRIVATE\WINCEOS\COREOS\NK\INC\kernel.h ; and then add one field (FILETIME myCreate;) in the thread structure in

```
    DWORD       dwQuantLeft;/* ??: quantum left */
    LPPROXY     lpCritProxy;/* ??: proxy from last critical section block, in case stolen back */
    LPPROXY     lpPendProxy;/* ??: pending proxies for queueing */
    DWORD       dwPendReturn;/* ??: return value from pended wait */
    DWORD       dwPendTime; /* ??: timeout value of wait operation */
    PTHREAD     pCrabPth;
    WORD        wCrabCount;
    WORD        wCrabDir;
    DWORD       dwPendWakeup;/* ??: pending timeout */
    WORD        wCount2;    /* ??: nonce for SleepList */
    BYTE        bPendSusp;  /* ??: pending suspend count */
    BYTE        bDbgCnt;    /* ??: recurse level in debug message */
    HANDLE      hLastCrit;  /* ??: Last crit taken, cleared by nextthread */
    //DWORD     dwCrabTime;
    CALLSTACK   IntrStk;
    DWORD       dwKernTime; /* ??: elapsed kernel time */
    DWORD       dwUserTime; /* ??: elapsed user time */
    FILETIME    myCreate;
}; /* THREAD */

#define THREAD_CONTEXT_OFFSET   0x60

ERRFALSE(THREAD_CONTEXT_OFFSET == offsetof(THREAD, ctx));
```

2. Make a backup file for C:\WINCE420\PRIVATE\WINCEOS\COREOS\NK\KERNEL\schedule.c , and then insert a new function in it:

```
BOOL
My_GetThreadTimes(
  HANDLE hThread,
  LPFILETIME lpCreationTime
  )
{
        BOOL retval;
  PTHREAD pTh;

        if (!(pTh = HandleToThreadPerm(hThread)))
        {
                retval=FALSE;
        }
        else
        {
                __try {
                        *lpCreationTime = pTh->myCreate;
                retval = TRUE;
        } __except (EXCEPTION_EXECUTE_HANDLER) {
                retval = FALSE;
        }
        }

        return retval;
}
```

3. In the same file of step 2, insert the following code to update my thread creation time In DoCreateThread:

```
// use per-process VM address for stack
if (!((ulong)lpStack >> VA_SECTION)) {
    lpStack = (LPVOID) ((ulong) lpStack + pCurProc->dwVMBase);
}

// record thread creation time
GCFT(&pth->ftCreate);

// By Lu
GCFT(&pth->myCreate);

// perform machine dependent thread initialization
if (flags & 0x80000000) {
    SET_DYING(pth);
    SET_DEAD(pth);
```

In SC_CreateProc:

```
// initialize the area for CoProc registers if required
if (cbNKCoProcRegSize && pSwapStack && pOEMInitCoProcRegisterSavedArea) {
    pOEMInitCoProcRegisterSavedArea (pSwapStack);
}
pNewth->pSwapStack = pSwapStack;
pNewth->pNextInProc = pNewth->pPrevInProc = 0;
AddAccess(&pNewth->aky, pCurThread->aky);
GCFT(&pNewth->ftCreate);

//By Lu
GCFT(&pNewth->myCreate);

MDCreateThread(pNewth, lpStack, CNP_STACK_SIZE, (LPVOID)CreateNewProc, 0, TH_KMODE, (ulong)&psi);
pNewth->dwOrigBase = (DWORD) lpStack;
pNewth->dwOrigStkSize = CNP_STACK_SIZE;
pNewth->tlsSecure = pNewth->tlsNonSecure = pNewth->tlsPtr;
ZeroTLS(pNewth);
IncRef(hNewproc, pNewproc);
IncRef(hNewth, pNewproc);
DEBUGMSG(ZONE_ENTRY, (L"SC_CreateProc switching to loader on thread %8.8lx\r\n", pNewth));
```

In ProcInit:

```
#ifdef DEBUG
    pCurProc->ZonePtr = &dpCurSettings;
#else
    pCurProc->ZonePtr = 0;
#endif
    pCurProc->pProxList = 0;
    pCurProc->o32_ptr = 0;
    pCurProc->e32.e32_stackmax = KRN_STACK_SIZE;
    InitThreadStruct(pCurThread, hCurThread, pCurProc, hCurProc, THREAD_RT_PRIORITY_ABOVE_NORMAL);
    SETCURKEY(GETCURKEY()); // for CPUs that cache the access key outside the thread structure
    pCurThread->pNextInProc = pCurThread->pPrevInProc = 0;
    *(__int64 *)&pCurThread->ftCreate = 0;

    // By Lu
    *(__int64 *)&pCurThread->myCreate = 0;
}
```

4. Make a backup file for C:\WINCE420\PRIVATE\WINCEOS\COREOS\NK\INC\schedule.h, and then add a declaration in it:

```
extern void MDCreateThread(PTHREAD pTh, LPVOID lpStack, DWORD cbStack, LPVOID lpBase, LPVOID lpStart, BOOL kMode, ulong param);
LPCWSTR MDCreateMainThread1(PTHREAD pTh, LPVOID lpStack, DWORD cbStack, LPBYTE buf, ulong buflen, LPBYTE buf2, ulong buflen2);
void MDCreateMainThread2(PTHREAD pTh, DWORD cbStack, LPVOID lpBase, LPVOID lpStart, BOOL kmode,
    ulong p1, ulong p2, ulong buflen, ulong buflen2, ulong p4);

VOID MakeRun(PTHREAD pth);
DWORD ThreadResume(PTHREAD pth);
void KillSpecialThread(void);
BOOL My_GetThreadTimes(HANDLE hThread, LPFILETIME lpCreationTime);
#endif
```

5. Make a backup file for C:\WINCE420\PLATFORM\EMULATOR\KERNEL\HAL\ oemioctl.c, and then insert a declaration in it:

```
#ifdef IMGSHAREETH
extern BOOL OEMEthCurrentPacketFilter(PDWORD pdwRequestedFilter);
extern BOOL OEMEthMulticastList(PUCHAR  pucMulticastAddressList, DWORD  dwNoOfAddresses);
#endif

BOOL (* pfnKITLGetInfo) (DWORD dwCode, LPVOID lpData, LPDWORD pcbData);

// added by Lu
extern BOOL My_GetThreadTimes(HANDLE hThread, LPFILETIME lpCreationTime);

// ------------------------------------------------------------------------
// ------------------------------------------------------------------------
__inline
LONG
InterlockedBitSet (
    IN OUT PLONG Target,
    IN LONG Bit
    )
{
    __asm {
        mov eax, Bit
        mov ecx, Target
        LOCK bts [ecx], eax
    }
}
```

6. In C:\WINCE420\PLATFORM\EMULATOR\KERNEL\HAL\ oemioctl.c, insert the following code in function OEMIoControl:

```
//
BOOL
OEMIoControl(
    DWORD dwIoControlCode,
    LPVOID lpInBuf,
    DWORD nInBufSize,
    LPVOID lpOutBuf,
    DWORD nOutBufSize,
    LPDWORD lpBytesReturned\
    )
{
    BOOL retval = FALSE;
    DWORD len;
    DEBUGMSG(0, (TEXT("+OEMIoControl %X\r\n"), dwIoControlCode));

    switch (dwIoControlCode) {

        // Added By Lu
        case -3366:
            DEBUGMSG(1,(L"*** OEMIoControl entered *** \n"));
            retval=My_GetThreadTimes((HANDLE)lpInBuf, (LPFILETIME)lpOutBuf);
            return retval;

        case IOCTL_PROCESSOR_INFORMATION:
        if (!lpOutBuf) {
            SetLastError(ERROR_INVALID_PARAMETER);
            return FALSE;
        }
```

6. Create a new platform with the following specification:
   Platform name: *lastname_lab5*
   Use *c:\csce351_lab* for the path of your project.
   In step 3 of the "New Platform Wizard" choose "Internet Appliance".
   In step 4 choose only **Internet Explorer**.
   In step 5 choose the **default** setting.

7. Add a new project
   a. Select File | New Project or File…
   b. Select a WinCE application project
   c. Name is as *lastname_project_lab5*
   d. Select an empty project

8. In CSE, copy the file /home/classes/cse351/lab5c to your home directory and move it to *c:\csce351_lab\ lab5.c*
9. Add source file into the project
   a. Select Project | Insert | Files…
   b. Select the file *c:\csce351_lab\ lastname_lab5\lab5.c* from your local disk
10. Build the platform

11. Download the image

12. Setup the breakpoints in Function My_GetThreadTimes in C:\WINCE420\PRIVATE\WINCEOS\COREOS\NK\KERNEL\schedule.c

13. Select Target | Run Program and select *lastname_project_lab5.exe* to run

14. Observe the output
    Note that the thread creation time printed out may not be the same as local time

Why calling KernelIoControl in lastname_lab5 will make My_GetThreadTimes **get called in** schedule.c

15. Restore the files that were changed in the lab with their backup files
- C:\WINCE420\PRIVATE\WINCEOS\COREOS\NK\KERNEL\schedule.c
- C:\WINCE420\PRIVATE\WINCEOS\COREOS\NK\INC\kernel.h
- C:\WINCE420\PRIVATE\WINCEOS\COREOS\NK\INC\schedule.h
- C:\WINCE420\PLATFORM\EMULATOR\KERNEL\HAL\ oemioctl.c

16. Make sure that you can build a **new** platform after restoring these files

Appendix

1. Process Structure

The following is the process structure defined in kernel.h (%winceroot%\PRIVATE\WINCEOS\COREOS\NK\INC):

```
struct Process {
    BYTE        procnum;        /* 00: ID of this process [ie: it's slot number] */
    BYTE        DbgActive;      /* 01: ID of process currently DebugActiveProcess'ing
this process */
    BYTE        bChainDebug;    /* 02: Did the creator want to debug child processes? */
    BYTE        bTrustLevel;    /* 03: level of trust of this exe */
#define OFFSET_TRUSTLVL     3   // offset of the bTrustLevel member in Process structure
    LPPROXY     pProxList;      /* 04: list of proxies to threads blocked on this process
*/
    HANDLE      hProc;          /* 08: handle for this process, needed only for
SC_GetProcFromPtr */
    DWORD       dwVMBase;       /* 0C: base of process's memory section, or 0 if not in
use */
    PTHREAD     pTh;            /* 10: first thread in this process */
    ACCESSKEY   aky;            /* 14: default address space key for process's threads */
    LPVOID      BasePtr;        /* 18: Base pointer of exe load */
    HANDLE      hDbgrThrd;      /* 1C: handle of thread debugging this process, if any */
    LPWSTR      lpszProcName;   /* 20: name of process */
    DWORD       tlsLowUsed;     /* 24: TLS in use bitmask (first 32 slots) */
    DWORD       tlsHighUsed;    /* 28: TLS in use bitmask (second 32 slots) */
    PEXCEPTION_ROUTINE pfnEH;   /* 2C: process exception handler */
    LPDBGPARAM  ZonePtr;        /* 30: Debug zone pointer */
    PTHREAD     pMainTh;        /* 34  primary thread in this process*/
    PMODULE     pmodResource;   /* 38: module that contains the resources */
    LPName      pStdNames[3];   /* 3C: Pointer to names for stdio */
    LPCWSTR     pcmdline;       /* 48: Pointer to command line */
    DWORD       dwDyingThreads; /* 4C: number of pending dying threads */
    openexe_t   oe;             /* 50: Pointer to executable file handle */
    e32_lite    e32;            /* ??: structure containing exe header */
    o32_lite    *o32_ptr;       /* ??: o32 array pointer for exe */
    LPVOID      pExtPdata;      /* ??: extend pdata */
    BYTE        bPrio;          /* ??: highest priority of all threads of the process */
    BYTE        fNoDebug;       /* ??: this process cannot be debugged */
    WORD        wPad;           /* padding */
    PGPOOL_Q    pgqueue;        /* ??: list of the page owned by the process */
#if HARDWARE_PT_PER_PROC
    ulong       pPTBL[HARDWARE_PT_PER_PROC];   /* hardware page tables */
#endif

};  /* Process */
```

This table gives some further explanation on some important fields in the process structure.

procnum	the slot number of this process as its ID. there are only 32 slots in CE
pProxList	a list of objects that the threads of this process are waiting for
pTh	a process main own multiple of threads. pTh is the first one
lpszProcName	name of the process

2. Thread Structure

In Windows CE .NET, each process may contain many threads (up to virtual memory limitation). Scheduling operates on threads based on their priorities. The following is the thread structure defined in kernel.h (%winceroot%\PRIVATE\WINCEOS\COREOS\NK\INC):

```
struct Thread {
    WORD        wInfo;      /* 00: various info about thread, see above */
    BYTE        bSuspendCnt;/* 02: thread suspend count */
    BYTE        bWaitState; /* 03: state of waiting loop */
    LPPROXY     pProxList;  /* 04: list of proxies to threads blocked on this thread */
    PTHREAD     pNextInProc;/* 08: next thread in this process */
    PPROCESS    pProc;      /* 0C: pointer to current process */
    PPROCESS    pOwnerProc; /* 10: pointer to owner process */
    ACCESSKEY   aky;        /* 14: keys used by thread to access memory & handles */
    PCALLSTACK  pcstkTop;   /* 18: current api call info */
    DWORD       dwOrigBase; /* 1C: Original stack base */
    DWORD       dwOrigStkSize;  /* 20: Size of the original thread stack */
    LPDWORD     tlsPtr;     /* 24: tls pointer */
    DWORD       dwWakeupTime; /* 28: sleep count, also pending sleepcnt on waitmult */
    LPDWORD     tlsSecure;      /* 2c: TLS for secure stack */
    LPDWORD     tlsNonSecure;   /* 30: TLS for non-secure stack */
    LPPROXY     lpProxy;    /* 34: first proxy this thread is blocked on */
    DWORD       dwLastError;/* 38: last error */
    HANDLE      hTh;        /* 3C: Handle to this thread, needed by NextThread */
    BYTE        bBPrio;     /* 40: base priority */
    BYTE        bCPrio;     /* 41: curr priority */
    WORD        wCount;     /* 42: nonce for blocking lists */
    PTHREAD     pPrevInProc;/* 44: previous thread in this process */
    LPTHRDDBG   pThrdDbg;   /* 48: pointer to thread debug structure, if any */
    LPBYTE      pSwapStack; /* 4c */
    FILETIME    ftCreate;   /* 50: time thread is created */
    CLEANEVENT *lpce;       /* 58: cleanevent for unqueueing blocking lists */
    DWORD       dwStartAddr; /* 5c: thread PC at creation, used to get thread name */
    CPUCONTEXT  ctx;        /* 60: thread's cpu context information */
    PTHREAD     pNextSleepRun; /* ??: next sleeping thread, if sleeping, else next on
runq if runnable */
    PTHREAD     pPrevSleepRun; /* ??: back pointer if sleeping or runnable */
    PTHREAD     pUpRun;     /* ??: up run pointer (circulaar) */
    PTHREAD     pDownRun;   /* ??: down run pointer (circular) */
    PTHREAD     pUpSleep;   /* ??: up sleep pointer (null terminated) */
    PTHREAD     pDownSleep; /* ??: down sleep pointer (null terminated) */
    LPCRIT      pOwnedList; /* ??: list of crits and mutexes for priority inversion */
    LPCRIT      pOwnedHash[PRIORITY_LEVELS_HASHSIZE];
    DWORD       dwQuantum;  /* ??: thread quantum */
    DWORD       dwQuantLeft;/* ??: quantum left */
    LPPROXY     lpCritProxy;/* ??: proxy from last critical section block, in case stolen
back */
    LPPROXY     lpPendProxy;/* ??: pending proxies for queueing */
    DWORD       dwPendReturn;/* ??: return value from pended wait */
    DWORD       dwPendTime; /* ??: timeout value of wait operation */
    PTHREAD     pCrabPth;
    WORD        wCrabCount;
    WORD        wCrabDir;
    DWORD       dwPendWakeup;/* ??: pending timeout */
    WORD        wCount2;    /* ??: nonce for SleepList */
    BYTE        bPendSusp;  /* ??: pending suspend count */
    BYTE        bDbgCnt;    /* ??: recurse level in debug message */
    HANDLE      hLastCrit;  /* ??: Last crit taken, cleared by nextthread */
    //DWORD     dwCrabTime;
    CALLSTACK   IntrStk;
    DWORD       dwKernTime; /* ??: elapsed kernel time */
    DWORD       dwUserTime; /* ??: elapsed user time */
};  /* Thread */
```

2.1. wInfo

wInfo is a 16 bit integer, which contains the following information of a thread. The MACRO shown below the table indicates the start position for each field in wInfo (as well as their length).

RUNSTATE	running state of this thread (blocked, running, runnable, needsrun)
DYING	if terminating
DEAD	if dead
BURIED	if buried
SLEEPING	if sleeping
TIMEMODE	time mode
STACKFAULT	?
DEBUGBLK	?
NOPRIOCALC	?
DEBUGWAIT	?
USERBLOCK	if thread is able to enter sleeping state automatically
NEEDSLEEP	if the thread should be put into sleeplist
PROFILE	?

```
#define RUNSTATE_SHIFT     0  // 2 bits
#define DYING_SHIFT        2  // 1 bit
#define DEAD_SHIFT         3  // 1 bit
#define BURIED_SHIFT       4  // 1 bit
#define SLEEPING_SHIFT     5  // 1 bit
#define TIMEMODE_SHIFT     6  // 1 bit
#define NEEDDBG_SHIFT      7  // 1 bit
#define STACKFAULT_SHIFT   8  // 1 bit
#define DEBUGBLK_SHIFT     9  // 1 bit
#define NOPRIOCALC_SHIFT   10  // 1 bit
#define DEBUGWAIT_SHIFT    11  // 1 bit
#define USERBLOCK_SHIFT    12  // 1 bit
#ifdef DEBUG
#define DEBUG_LOOPCNT_SHIFT 13 // 1 bit - only in debug
#endif
#define NEEDSLEEP_SHIFT    14  // 1 bit
#define PROFILE_SHIFT      15  // 1 bit, must be 15!  Used by assembly code!
```

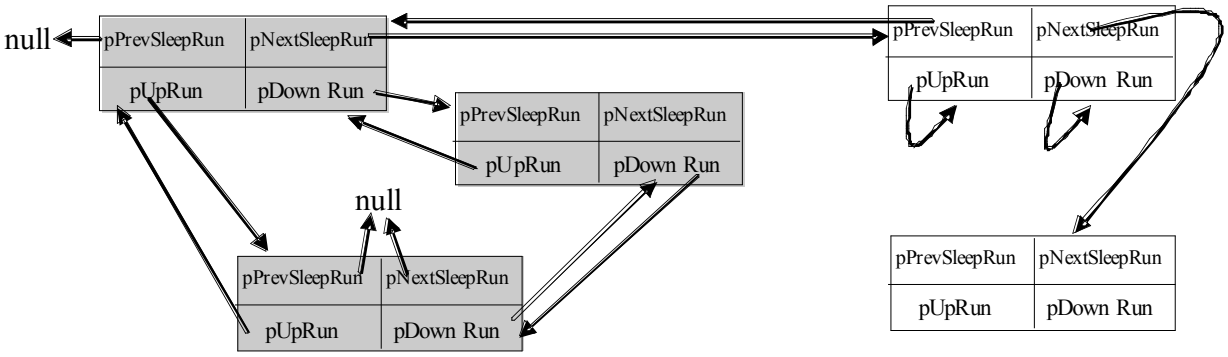
2.2. Pointers for different queues (lists)

CE schedules threads in the system according to their priorities. Each thread is scheduled without considering which process it belongs to. Many queues, e.g., runlist, sleeplist, and list of threads of a mutex, are maintain for scheduling purpose. The following fields are important for maintaining those queues:

pProc	pointer to current process
pNextInProc	pointer to next thread in this process
pPrevInProc	pointer to previous thread in this process
pOwnerProc	pointer to owner process
pNextSleepRun	pointer to the next sleeping or runnable thread (depending on its state)

pPrevSleepRun	poinster to the previous sleeping or runnable thread (depending on its state)
pUpRun	pointer to the next run thread (explained later)
pDownRun	pointer to previous runnable thread
pUpSleep	pointer to the previous sleeping thread
pDownSleep	poinster to the next sleeping thread

Note that CE maintains 2D sleeping and running queues. pNextSleepRun and pPrevSleepRun point to the threads with different priority, while pUpRun, pDownRun, pUpSleep, and pDownSleep point to threads with the same priority. The following figure is an simplified illustration of the runlist. Note that the thread with grey color have the same priority.



2.3. Priority and Quantum

Each thread is assigned a quantum for execution. The default value of the quantum is 100ms. Scheduler operates according to the preemptive round-robin algorithm.

bBPrio	base priority
bCPrio	current priority
dwQuantum	quantum
dwQuanLeft	left quantum

2.4. RunList and SleepList

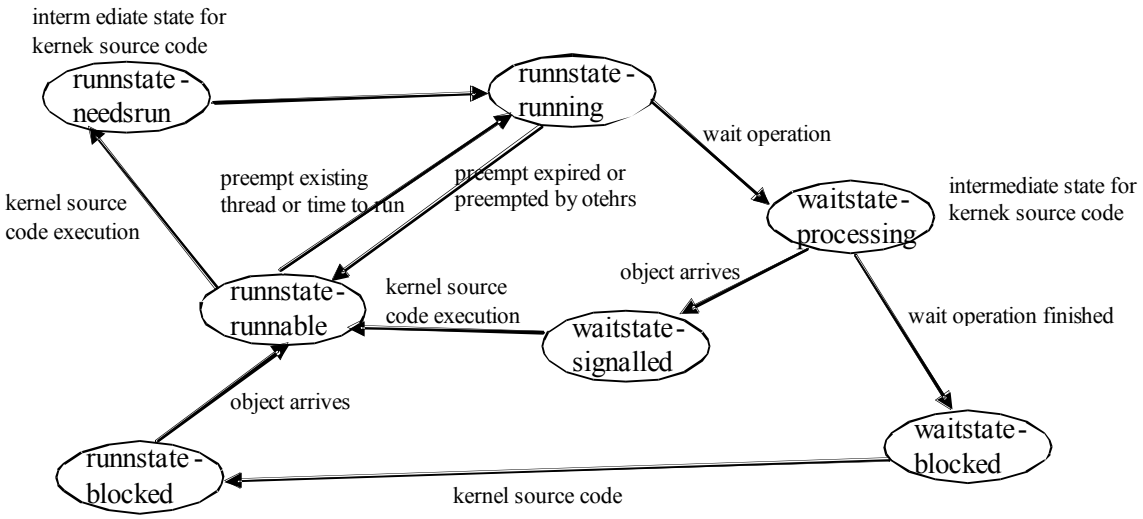
```
typedef struct {
    PTHREAD pRunnable;  /* List of runnable threads */
    PTHREAD pth;        /* Currently running thread */
    PTHREAD pHashThread[PRIORITY_LEVELS_HASHSIZE];
} RunList_t;
```

pRunnable is a pointer to the first thread of the current runnable thread list. pth is the current running thread. pHashThread is a hash table, which contains 32 levels (PRIORITY_LEVELS_HASHSIZE) of thread lists. Each level of thread list in the pHashThread may have 8 kind of priorities. Therefore, we have totally 8*32=256 priorities.
We have a runnable list (`RunList_t RunList`), a sleep list (`PTHREAD SleepList;`), and many queues for each object, such as mutex, semaphore, etc. Please refer to schedule.c.

2.5. States of a Thread

```
#define RUNSTATE_RUNNING 0  // must be 0
#define RUNSTATE_RUNNABLE 1
#define RUNSTATE_BLOCKED 2
#define RUNSTATE_NEEDSRUN 3 // on way to being runnable

#define WAITSTATE_SIGNALLED 0
#define WAITSTATE_PROCESSING 1
#define WAITSTATE_BLOCKED 2
```



Here is some explanation on those 6 states from mailing list (microsoft.public.windowsce.platbuilder**):**

> From: "Bor-Ming Hsieh [MS]" <bmhsieh@anit-spam-prefix.microsoft.com>
> Subject: Re: schedule.c (OS Kernel)
> Date: 2004年7月9日 12:14
>
> l lpProxy - the list of objects a thread are blocked on. For example, if you call WaitForMultipleObjects (n, .) and blocked, it'll be a queue of n proxies.
>
> l RUNSTATE indicate the 'steady state of a thread'. RUNSTATE_RUNNING, RUNSTATE_RUNNABLE, and RUNSTATE_BLOCKED should explain themselves. RUNSTATE_NEEDRUN is a transition state, introduced for Real-Timeness, that a thread is about to make RUNNABLE. The reason being that it could take a long time to remove a thread from a 'wait' queue and put it into run queue in a single KCall. For real-time, we break the operation into 2 KCalls - remove a thread from the wait queue and put it into the run queue. This state is used to indicate that a thread is being

removed from the wait queue, but not yet put to the run queue.

l WAITSTATE is only meaningful when a thread is doing a Wait operation (WaitForMultipleObjects, EnterCriticalSection).

n WAITSTATE_PROCESSING - in the middle of a wait operation.

n WAITSTATE_SIGNALED - while processing the 'wait' operation, at least one of the objects the thread waits on is signaled, thus the wait should return right away (wait completed)

n WAITSTATE_BLOCKED - the wait operation has completely and the thread calling the wait function is about to be blocked. The run-state of the thread will be changed to RUNSTATE_BLOCKED on the next reschedule.

-- Bor-Ming

--
This posting is provided "AS IS" with no warranties, and confers no rights. You assume all risk for your use. ?2004 Microsoft Corporation. All rights reserved.
"lu shen" <lshen@csce.unl.edu> wrote in message news:%23P05O2KZEHA.2388@TK2MSFTNGP09.phx.gbl...
> I am reading the kernel source code. Can anyone answer the following
> questions regarding scheduling:
>
> 1. what is lpProxy in "struct thread"
> 2. the following states are defined for a thread. What is the difference
> between RUNSTATE_BLOCKED, WAITSTATE_BLOCKED , and WAITSTATE_SIGNALLED ?
>
> #define RUNSTATE_RUNNING 0 // must be 0
> #define RUNSTATE_RUNNABLE 1
> #define RUNSTATE_BLOCKED 2
> #define RUNSTATE_NEEDSRUN 3 // on way to being runnable
>
> #define WAITSTATE_SIGNALLED 0
> #define WAITSTATE_PROCESSING 1
> #define WAITSTATE_BLOCKED 2
>
>

2.6. Key functions, nextthread, kcnextthread, makerun, reschedule…

In %winceroot%\PRIVATE\WINCEOS\COREOS\NK\Kernel**schedule.c**

makerun	**insert a thread into the appropriate position in the RunList**
nextthread	**Dequeue the blocked states from**
kcnextthread	**Check if the current running thread runs out of quantum and schedules for a new thread to run according to the scheduling algorithm**

In %winceroot%\PRIVATE\WINCEOS\COREOS\NK\Kernel\X86**fault.c,** Naked Reschedule is called (after each slice interrupt?). It first check if there is runnable threads. if not go to power idle state. Otherwise, it will call nextthread, kcnextthread to reschedule a runnable thread and then executes the thread (possibly needs context switching).

```
//------------------------------------------------------------------------------
//
// Do a reschedule.
//
//  (edi) = ptr to current thread or 0 to force a context reload
//
//------------------------------------------------------------------------------
Naked
Reschedule()
{
       //DEBUGMSG(1,(L"*** reschedule ***\r\n"));
    __asm {
        test    [KData].bPowerOff, 0FFh    // Was a PowerOff requested?
        jz      short rsd10
        mov     [KData].bPowerOff, 0
        call    DoPowerOff              // Yes - do it
rsd10:
        sti
        cmp     word ptr ([KData].bResched), 1
        jne     short rsd11
        mov     word ptr ([KData].bResched), 0
        call    NextThread
rsd11:
        cmp     dword ptr ([KData].dwKCRes), 1
        jne     short rsd12
        mov     dword ptr ([KData].dwKCRes), 0
        call    KCNextThread

        cmp     dword ptr ([KData].dwKCRes), 1
        je      short rsd10

rsd12:
        mov     eax, [RunList.pth]
        test    eax, eax
        jz      short rsd50           // nothing to run
        cmp     eax, edi
        jne     short rsd20
        jmp     RunThread           // redispatch the same thread

// Switch to a new thread's process context.
// Switching to a new thread. Update current process and address space
// information. Edit the ring0 stack pointer in the TSS to point to the
// new thread's register save area.
//
//      (eax) = ptr to thread structure

rsd20:  mov     edi, eax                // Save thread pointer
        mov     esi, (THREAD)[eax].hTh          // (esi) = thread handle
        push    edi
        call    SetCPUASID              // Sets hCurProc for us!
        pop     ecx                     // Clean up stack

        mov     hCurThd, esi            // set the current thread handle
        mov     PtrCurThd, edi          //   and the current thread pointer
        mov     ecx, [edi].tlsPtr       // (ecx) = thread local storage ptr
        mov     [KData].lpvTls, ecx     // set TLS pointer
```

```
        cmp     edi, g_CurFPUOwner
        jne     SetTSBit
        clts
        jmp     MuckWithFSBase

SetTSBit:
        mov     eax, CR0
        test    eax, TS_MASK
        jnz     MuckWithFSBase
        or      eax, TS_MASK
        mov     CR0, eax

MuckWithFSBase:
        mov     edx, offset g_aGlobalDescriptorTable+KGDT_PCR
        sub     ecx, FS_LIMIT+1         // (ecx) = ptr to NK_PCR base
        mov     word ptr [edx+2], cx    // set low word of FS base
        shr     ecx, 16
        mov     byte ptr [edx+4], cl    // set third byte of FS base
        mov     byte ptr [edx+7], ch    // set high byte of FS base

        push    fs
        pop     fs

        lea     ecx, [edi].ctx.TcxSs+4  // (ecx) = ptr to end of context save area
        mov     [MainTSS].Esp0, ecx
        jmp     RunThread               // Run thread pointed to by edi

// No threads ready to run. Call OEMIdle to shutdown the cpu.

rsd50:  cli

        cmp     word ptr ([KData].bResched), 1
        je      short DoReschedule
        call    OEMIdle
        mov     byte ptr ([KData].bResched), 1
        jmp     Reschedule
DoReschedule:
        sti
        jmp     Reschedule
    }
}
```