Mark3 Realtime Kernel

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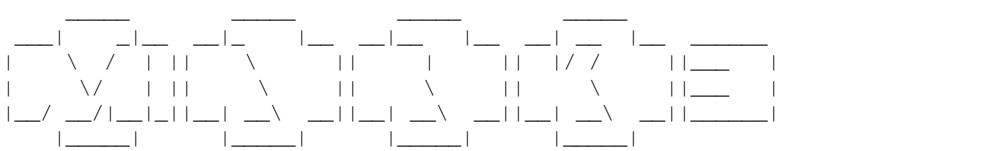
The Mark3 Realtime Kernel



```
--[Mark3 Realtime Platform]----------------------------------------------
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The Mark3 Realtime Kernel is a completely free, open-source, real-time operating system aimed at bringing multi-tasking to microcontroller systems without MMUs.

It uses modern programming languages and concepts (it's written entirely in C++) to minimize code duplication, and its object-oriented design enhances readibility. The API is simple - there are only six functions required to set up the kernel, initialize threads, and start the scheduler.

The source is fully-documented with example code provided to illustrate concepts. The result is a performant RTOS, which is easy to read, easy to understand, and easy to extend to fit your needs.

But Mark3 is bigger than just a real-time kernel, it also contains a number of class-leading features:

- Device driver HAL which provides a meaningful abstraction around device-specific peripherals.
- Capable recursive-make driven build system which can be used to build all libraries, examples, tests, and documentation for any number of targets from the command-line.
- Graphics and UI code designed to simplify the implementation of systems using displays, keypads, joysticks, and touchscreens
- Standards-based custom communications protocol used to simplify the creation of host tools
- A bulletproof, well-documented bootloader for AVR microcontrollers

Chapter 2

Preface

2.1 Who should read this

As the cover clearly states, this is a book about the Mark3 real-time kernel. I assume that if you're reading this book you have an interest in some, if not all, of the following subjects:

- Embedded systems
- Real-time systems
- Operating system kernel design

And if you're interested in those topics, you're likely familiar with C and C++ and the more you know, the easier you'll find this book to read. And if C++ scares you, and you don't like embedded, real-time systems, you're probably looking for another book. If you're unfamiliar with RTOS fundamentals, I highly suggest searching through the vast amount of RTOS-related articles on the internet to familiarize yourself with the concepts.

2.2 Why Mark3?

My first job after graduating from university in 2005 was with a small company that had a very old-school, low-budget philosophy when it came to software development. Every make-or-buy decision ended with "make" when it came to tools. It was the kind of environment where vendors cost us money, but manpower was free. In retrospect, we didn't have a ton of business during the time that I worked there, and that may have had something to do with the fact that we were constantly short on ready cash for things we could code ourselves.

Early on, I asked why we didn't use industry-standard tools - like JTAG debuggers or IDEs. One senior engineer scoffed that debuggers were tools for wimps - and something that a good programmer should be able to do without. After all - we had serial ports, GPIOs, and a bi-color LED on our boards. Since these were built into the hardware, they didn't cost us a thing. We also had a single software "build" server that took 5 minutes to build a 32k binary on its best days, so when we had to debug code, it was a painful process of trial and error, with lots of Youtube between iterations. We complained that tens of thousands of dollars of productivity was being flushed away that could have been solved by implementing a proper build server - and while we eventually got our wish, it took far more time than it should have.

Needless to say, software development was painful at that company. We made life hard on ourselves purely out of pride, and for the right to say that we walked "up-hills both ways through 3 feet of snow, everyday". Our code was tied ever-so-tightly to our hardware platform, and the system code was indistinguishable from the application. While we didn't use an RTOS, we had effectively implemented a 3-priority threading scheme using a carefully designed interrupt nesting scheme with event flags and a while(1) superloop running as a background thread. Nothing was abstracted, and the code was always optimized for the platform, presumably in an effort to save on code size and wasted cycles. I asked why we didn't use an RTOS in any of our systems and received dismissive scoffs - the overhead from thread switching and maintaining multiple threads could not be tolerated in our systems according

to our chief engineers. In retrospect, our ad-hoc system was likely as large as my smallest kernel, and had just as much context switching (althrough it was hidden by the compiler).

And every time a new iteration of our product was developed, the firmware took far too long to bring up, because the algorithms and data structures had to be re-tooled to work with the peripherals and sensors attached to the new boards. We worked very hard in an attempt to reinvent the wheel, all in the name of producing "efficient" code.

Regardless, I learned a lot about software development.

Most important, I learned that good design is the key to good software; and good design doesn't have to come at a price. In all but the smallest of projects, the well-designed, well-abstracted code is not only more portable, but it's usually smaller, easier to read, and easier to reuse.

Also, since we had all the time in the world to invest in developing our own tools, I gained a lot of experience building them, and making use of good, free PC tools that could be used to develop and debug a large portion of our code. I ended up writing PC-based device and peripheral simulators, state-machine frameworks, and abstractions for our horrible ad-hoc system code. At the end of the day, I had developed enough tools that I could solve a lot of our development problems without having to re-inventing the wheel at each turn. Gaining a background in how these tools worked gave me a better understanding of how to use them - making me more productive at the jobs that I've had since.

I am convinced that designing good software takes honest effort up-front, and that good application code cannot be written unless it is based on a solid framework. Just as the wise man builds his house on rocks, and not on sand, wise developers write applications based on a well-defined platforms. And while you can probably build a house using nothing but a hammer and sheer will, you can certainly build one a lot faster with all the right tools.

This conviction lead me to development my first RTOS kernel in 2009 - FunkOS. It is a small, yet surprisingly full-featured kernel. It has all the basics (semaphores, mutexes, round-robin and preemptive scheduling), and some pretty advanced features as well (device drivers and other middleware). However, it had two major problems - it doesn't scale well, and it doesn't support many devices.

While I had modest success with this kernel (it has been featured on some blogs, and still gets around 125 downloads a month), it was nothing like the success of other RTOS kernels like uC/OS-II and FreeRTOS. To be honest, as a one-man show, I just don't have the resources to support all of the devices, toolchains, and evaluation boards that a real vendor can. I had never expected my kernel to compete with the likes of them, and I don't expect Mark3 to change the embedded landscape either.

My main goal with Mark3 was to solve the technical shortfalls in the FunkOS kernel by applying my experience in kernel development. As a result, Mark3 is better than FunkOS in almost every way; it scales better, has lower interrupt latency, and is generally more thoughtfully designed (all at a small cost to code size).

Another goal I had was to create something easy to understand, that could be documented and serve as a good introduction to RTOS kernel design. The end result of these goals is the kernel as presented in this book - a full source listing of a working OS kernel, with each module completely documented and explained in detail.

Finally, I wanted to prove that a kernel written entirely in C++ could perform just as well as one written in C, without incurring any extra overhead. Comparing the same configuration of Mark2 to Mark3, the code size is remarkably similar, and the execution performance is just as good. Not only that, but there are fewer lines of code. The code is more readable and easier to understand as a result of making use of object-oriented concepts provided by C++. Applications are easier to write because common concepts are encapsulated into objects (Threads, Semaphores, Mutexes, etc.) with their own methods and data, as opposed to APIs which rely on lots of explicit pointer-passing, type casting, and other operations that are typically considered "unsafe" or "advaned topics" in C.

Chapter 3

Can you Afford an RTOS?

Of course, since you're reading the manual for an RTOS that I've been developing for the last few years, you can guess that the conclusion that I draw is a resounding "yes".

If your code is of any sort of non-trivial complexity (say, at least a few-thousand lines), then a more appropriate question would be "can you afford not to use an RTOS in your system?".

In short, there are simply too many benefits of an RTOS to ignore.

- Sophisticated synchronization objects
- The ability to efficiently block and wait
- Enhanced responsiveness for high-priority tasks
- Built in timers
- Built in efficient memory management

Sure, these features have a cost in code space and RAM, but from my experience the cost of trying to code around a lack of these features will cost you as much - if not more. The results are often far less maintainable, error prone, and complex. And that simply adds time and cost. Real developers ship, and the RTOS is quickly becoming one of the standard tools that help keep developers shipping.

3.1 Intro

(Note - this article was written for the C-based Mark2 kernel, which is slightly different. While the general principles are the same, the numbers are not an 100% accurate reflection of the current costs of the Mark3 kernel.)

One of the main arguments against using an RTOS in an embedded project is that the overhead incurred is too great to be justified. Concerns over "wasted" RAM caused by using multiple stacks, added CPU utilization, and the "large" code footprint from the kernel cause a large number of developers to shun using a preemptive RTOS, instead favoring a non-preemptive, application-specific solution.

I believe that not only is the impact negligible in most cases, but that the benefits of writing an application with an RTOS can lead to savings around the board (code size, quality, reliability, and development time). While these other benefits provide the most compelling case for using an RTOS, they are far more challenging to demonstrate in a quantitative way, and are clearly documented in numerous industry-based case studies.

While there is some overhead associated with an RTOS, the typical arguments are largely unfounded when an RTOS is correctly implemented in a system. By measuring the true overhead of a preemptive RTOS in a typical application, we will demonstrate that the impact to code space, RAM, and CPU usage is minimal, and indeed acceptable for a wide range of CPU targets.

To illustrate just how little an RTOS impacts the size of an embedded software design we will look at a typical microcontroller project and analyze the various types of overhead associated with using a pre-emptive realtime kernel versus a similar non-preemptive event-based framework.

RTOS overhead can be broken into three distinct areas:

- Code space: The amount of code space eaten up by the kernel (static)
- Memory overhead: The RAM associated wtih running the kernel and application threads.
- Runtime overhead: The CPU cycles required for the kernel's functionality (primarily scheduling and thread switching)

While there are other notable reasons to include or avoid the use of an RTOS in certain applications (determinism, responsiveness, and interrupt latency among others), these are not considered in this discussion - as they are difficult to consider for the scope of our "canned" application. Application description:

For the purpose of this comparison, we first create an application using the standard preemptive Mark3 kernel with 2 system threads running: A foreground thread and a background thread. This gives three total priority levels in the system - the interrupt level (high), and two application priority threads (medium and low), which is quite a common paradigm for microcontroller firmware designs. The foreground thread processes a variety of time-critical events at a fixed frequency, while the background thread processes lower priority, aperiodic events. When there are no background thread events to process, the processor enters its low-power mode until the next interrupt is acknowledged.

The contents of the threads themselves are unimportant for this comparison, but we can assume they perform a variety of I/O using various user-input devices and a serial graphics display. As a result, a number of Mark3 device drivers are also implemented.

The application is compiled for an ATMega328p processor which contains 32kB of code space in flash, and 2kB of RAM, which is a lower-mid-range microcontroller in Atmel's 8-bit AVR line of microcontrollers. Using the WinAVR GCC compiler with -O2 level optimizations, an executable is produced with the following code/RAM utilization:

31600 Bytes Code Space 2014 Bytes RAM

An alternate version of this project is created using a custom "super-loop" kernel, which uses a single application thread and provides 2 levels of priority (interrupt and application). In this case, the event handler processes the different priority application events to completion from highest to lowest priority.

This approach leaves the application itself largely unchanged. Using the same optimization levels as the preemptive kernel, the code compiles as follows:

29904 Bytes Code Space 1648 Bytes RAM

3.2 Memory overhead:

At first glance, the difference in RAM utilization seems quite a lot higher for the preemptive mode version of the application, but the raw numbers don't tell the whole story.

The first issue is that the cooperative-mode total does not take into account the system stack - whereas these values are included in the totals for RTOS version of the project. As a result, some further analysis is required to determine how the stack sizes truly compare.

In cooperative mode, there is only one thread of execution - so considering that multiple event handlers are executed in turn, the stack requirements for cooperative mode is simply determined by those of the most stack-intensive event handler.

In contrast, the preemptive kernel requires a separate stack for each active thread, and as a result the stack usage of the system is the sum of the stacks for all threads.

Since the application and idle events are the same for both preemptive and cooperative mode, we know that their (independent) stack requirements will be the same in both cases.

For cooperative mode, we see that the idle thread stack utilization is lower than that of the application thread, and so the application thread's determines the stack size requirement. Again, with the preemptive kernel the stack utilization is the sum of the stacks defined for both threads.

As a result, the difference in overhead between the two cases becomes the extra stack required for the idle thread - which in our case is (a somewhat generous) 64 bytes.

The numbers still don't add up completely, but looking into the linker output we see that the rest of the difference comes from the extra data structures used to declare the threads in preemptive mode.

With this taken into account, the true memory cost of a 2-thread system ends up being around 150 bytes of RAM - which is less than 8% of the total memory available on this particular microcontroller. Whether or not this is reasonable certainly depends on the application, but more importantly, it is not so unreasonable as to eliminate an RTOS-based solution from being considered.

3.3 Code Space Overhead:

The difference in code space overhead between the preemptive and cooperative mode solutions is less of an issue. Part of this reason is that both the preemptive and cooperative kernels are relatively small, and even an average target device (like the Atmega328 we've chosen) has plenty of room.

Mark3 can be configured so that only features necessary for the application are included in the RTOS - you only pay for the parts of the system that you use. In this way, we can measure the overhead on a feature-by-feature basis, which is shown below for the kernel as configured for this application:

3466 Bytes

The configuration tested in this comparison uses the thread/port module with timers, drivers, and semaphores, for a total kernel size of $\sim$3.5KB, with the rest of the code space occupied by the application.

The custom cooperative-mode framework has a similar structure which is broken down by module as follows:

1850 Bytes

As can be seen from the compiler's output, the difference in code space between the two versions of the application is about 1.7kB - or about 5% of the available code space on the selected processor. While nearly all of this comes from the added overhead of the kernel, the rest of the difference comes the changes to the application necessary to facilitate the different frameworks.

3.4 Runtime Overhead

On the cooperative kernel, the overhead associated with running the thread is the time it takes the kernel to notice a pending event flag and launch the appropriate event handler, plus the timer interrupt execution time.

Similarly, on the preemptive kernel, the overhead is the time it takes to switch contexts to the application thread, plus the timer interrupt execution time.

The timer interrupt overhead is similar for both cases, so the overhead then becomes the difference between the following:

Preemptive mode:

- Posting the semaphore that wakes the high-priority thread
- Performing a context switch to the high-priority thread

Cooperative mode:

- Setting the high-priority thread's event flag
- Acknowledging the event from the event loop

Using the cycle-accurate AVR simulator, we find the end-to-end event sequence time to be 20.4us for the cooperative mode scheduler and 44.2us for the preemptive, giving a difference of 23.8us.

With a fixed high-priority event frequency of 33Hz, we achieve a runtime overhead of 983.4us per second, or 0.-0983% of the total available CPU time. Now, obviously this value would expand at higher event frequencies and/or slower CPU frequencies, but for this typical application we find the difference in runtime overhead to be neglible for a preemptive system. Analysis:

For the selected test application and platform, including a preemptive RTOS is entirely reasonable, as the costs are low relative to a non-preemptive kernel solution. But these costs scale relative to the speed, memory and code space of the target processor. Because of these variables, there is no "magic bullet" environment suitable for every application, but Mark3 attempts to provide a framework suitable for a wide range of targets.

On the one hand, if these tests had been performed on a higher-end microcontroller such as the ATMega1284p (containing 128kB of code space and 16kB of RAM), the overhead would be in the noise. For this type of resource-rich microcontroller, there would be no reason to avoid using the Mark3 preemptive kernel.

Conversely, using a lower-end microcontroller like an ATMega88pa (which has only 8kB of code space and 1k-B of RAM), the added overhead would likely be prohibitive for including a preemptive kernel. In this case, the cooperative-mode kernel would be a better choice.

As a rule of thumb, if one budgets 10% of a microcontroller's code space/RAM for a preemptive kernel's overhead, you should only require at minimum a microcontroller with 16k of code space and 2kB of RAM as a base platform for an RTOS. Unless there are serious constraints on the system that require much better latency or responsiveness than can be achieved with RTOS overhead, almost any modern platform is sufficient for hosting a kernel. In the event you find yourself with a microprocessor with external memory, there should be no reason to avoid using an RTOS at all.

Chapter 4

Superloops

4.1 Intro to Superloops

Before we start taking a look at designing a real-time operating system, it's worthwhile taking a look through one of the most-common design patterns that developers use to manage task execution in embedded systems - Superloops.

Systems based on superloops favor the system control logic baked directly into the application code, usually under the guise of simplicity, or memory (code and RAM) efficiency. For simple systems, superloops can definitely get the job done. However, they have some serious limitations, and are not suitable for every kind of project. In a lot of cases you can squeak by using superloops - especially in extremely constrained systems, but in general they are not a solid basis for reusable, portable code.

Nonetheless, a variety of examples are presented here- from the extremely simple, to cooperative and liimted-preemptive multitasking systems, all of which are examples are representative of real-world systems that I've either written the firmware for, or have seen in my experience.

4.2 The simplest loop

Let's start with the simplest embedded system design possible - an infinite loop that performs a single task repeatedly:

```
int main()
{
    while(1)
    {
        Do_Something();
    }
}
```

Here, the code inside the loop will run a single function forever and ever. Not much to it, is there? But you might be surprised at just how much embedded system firmware is implemented using essentially the same mechanism - there isn't anything wrong with that, but it's just not that interesting.

While the execution timeline for this program is equally boring, for the sake of completeness it would look like this:

Despite its simplicity we can see the beginnings of some core OS concepts. Here, the while(1) statement can be logically seen as the he operating system kernel - this one control statement determines what tasks can run in the system, and defines the constraints that could modify their execution. But at the end of the day, that's a big part of what a kernel is - a mechanism that controls the execution of application code.

The second concept here is the task. This is application code provided by the user to perform some useful purpose in a system. In this case Do_something() represents that task - it could be monitoring blood pressure, reading a sensor and writing its data to a terminal, or playing an MP3; anything you can think of for an embedded system to do. A simple round-robin multi-tasking system can be built off of this example by simply adding additional tasks in

sequence in the main while-loop. Note that in this example the CPU is always busy running tasks - at no time is the CPU idle, meaning that it is likely burning a lot of power.

While we conceptually have two separate pieces of code involved here (an operating system kernel and a set of running tasks), they are not logically separate. The OS code is indistinguishable from the application. It's like a single-celled organism - everything is crammed together within the walls of an indivisible unit; and specialized to perform its given function relying solely on instinct.

4.3 Interrupt-Driven Super-loop

In the previous example, we had a system without any way to control the execution of the task- it just runs forever. There's no way to control when the task can (or more importantly can't) run, which greatly limits the usefulness of the system. Say you only want your task to run every 100 miliseconds - in the previous code, you have to add a hard-coded delay at the end of your task's execution to ensure your code runs only when it should.

Fortunately, there is a much more elegant way to do this. In this example, we introduce the concept of the synchronization object. A Synchronization object is some data structure which works within the bounds of the operating system to tell tasks when they can run, and in many cases includes special data unique to the synchronization event. There are a whole family of synchronization objects, which we'll get into later. In this example, we make use of the simplest synchronization primitive - the global flag.

With the addition of synchronization brings the addition of event-driven systems. If you're programming a microcontroller system, you generally have scores of peripherals available to you - timers, GPIOs, ADCs, UARTs, ethernet, USB, etc. All of which can be configured to provide a stimulus to your system by means of interrupts. This stimulus gives us the ability not only to program our micros to do_something(), but to do_something() if-and-only-if a corresponding trigger has occurred.

The following concepts are shown in the example below:

```
volatile K_BOOL something_to_do = false;

__interrupt__ My_Interrupt_Source(void)
{
    something_to_do = true;
}

int main()
{
    while(1)
    {
        if( something_to_do )
        {
            Do_something();
            something_to_do = false;
        }
        else
        {
            Idle();
        }
    }
}
```

So there you have it - an event driven system which uses a global variable to synchronize the execution of our task based on the occurrence of an interrupt. It's still just a bare-metal, OS-baked-into-the-aplication system, but it's introduced a whole bunch of added complexity (and control!) into the system.

The first thing to notice in the source is that the global variable, something_to_do, is used as a synchronization object. When an interrupt occurs from some external event, triggering the My_Interrupt_Source() ISR, program flow in main() is interrupted, the interrupt handler is run, and something_to_do is set to true, letting us know that when we get back to main(), that we should run our Do_something() task.

Another new concept at play here is that of the idle function. In general, when running an event driven system, there are times when the CPU has no application tasks to run. In order to minimize power consumption, CPUs usually contain instructions or registers that can be set up to disable non-essential subsets of the system when there's nothing to do. In general, the sleeping system can be re-activated quickly as a result of an interrupt or other external stimulus, allowing normal processing to resume.

Now, we could just call Do_something() from the interrupt itself - but that's generally not a great solution. In general, the more time we spend inside an interrupt, the more time we spend with at least some interrupts disabled. As a result, we end up with interrupt latency. Now, in this system, with only one interrupt source and only one task this might not be a big deal, but say that Do_something() takes several seconds to complete, and in that time several other interrupts occur from other sources. While executing in our long-running interrupt, no other interrupts can be processed - in many cases, if two interrupts of the same type occur before the first is processed, one of these interrupt events will be lost. This can be utterly disastrous in a real-time system and should be avoided at all costs. As a result, it's generally preferable to use synchronization objects whenever possible to defer processing outside of the ISR.

Another OS concept that is implicitly introduced in this example is that of task priority. When an interrupt occurs, the normal execution of code in main() is preempted: control is swapped over to the ISR (which runs to completion), and then control is given back to main() where it left off. The very fact that interrupts take precedence over what's running shows that main is conceptually a "low-priority" task, and that all ISRs are "high-priority" tasks. In this example, our "high-priority" task is setting a variable to tell our "low-priority" task that it can do something useful. We will investigate the concept of task priority further in the next example.

Preemption is another key principle in embedded systems. This is the notion that whatever the CPU is doing when an interrupt occurs, it should stop, cache its current state (referred to as its context), and allow the high-priority event to be processed. The context of the previous task is then restored its state before the interrupt, and resumes processing. We'll come back to preemption frequently, since the concept comes up frequently in RTOS-based systems.

4.4 Cooperative multi-tasking

Our next example takes the previous example one step further by introducing cooperative multi-tasking:

```
// Bitfield values used to represent three distinct tasks
#define TASK_1_EVENT (0x01)
#define TASK_2_EVENT (0x02)
#define TASK_3_EVENT (0x04)

volatile K_UCHAR event_flags = 0;

// Interrupt sources used to trigger event execution

__interrupt__  My_Interrupt_1(void)
{
    event_flags |= TASK_1_EVENT;
}

__interrupt__ My_Interrupt_2(void)
{
    event_flags |= TASK_2_EVENT;
}

__interrupt__ My_Interrupt_3(void)
{
    event_flags |= TASK_3_EVENT;
}

// Main tasks
int main(void)
{
    while(1)
    {
        while(event_flags)
        {
            if( event_flags & TASK_1_EVENT)
            {
                Do_Task_1();
                event_flags &= ~TASK_1_EVENT;
            } else if( event_flags & TASK_2_EVENT) {
                Do_Task_2();
                event_flags &= ~TASK_2_EVENT;
            } else if( event_flags & TASK_3_EVENT) {
                Do_Task_3();
                event_flags &= ~TASK_3_EVENT;
            }
        }
        Idle();
    }
}
```

This system is very similar to what we had before - however the differences are worth discussing. First, we have stimulus from multiple interrupt sources: each ISR is responsible for setting a single bit in our global event flag, which is then used to control execution of individual tasks from within main().

Next, we can see that tasks are explicitly given priorities inside the main loop based on the logic of the if/else if structure. As long as there is something set in the event flag, we will always try to execute Task1 first, and only when Task1 isn't set will we attempt to execute Task2, and then Task 3. This added logic provides the notion of priority. However, because each of these tasks exist within the same context (they're just different functions called from our main control loop), we don't have the same notion of preemption that we have when dealing with interrupts.

That means that even through we may be running Task2 and an event flag for Task1 is set by an interrupt, the CPU still has to finish processing Task2 to completion before Task1 can be run. And that's why this kind of scheduling is referred to ascooperative multitasking: we can have as many tasks as we want, but unless they cooperate by means of returning back to main, the system can end up with high-priority tasks getting starved for CPU time by lower-priority, long-running tasks.

This is one of the more popular Os-baked-into-the-application approaches, and is widely used in a variety of real-time embedded systems.

4.5 Hybrid cooperative/preemptive multi-tasking

The final variation on the superloop design utilizes software-triggered interrupts to simulate a hybrid cooperative/pre-emptive multitasking system. Consider the example code below.

```
// Bitfields used to represent high-priority tasks.  Tasks in this group
// can preempt tasks in the group below - but not eachother.
#define HP_TASK_1        (0x01)
#define HP_TASK_2        (0x02)

volatile K_UCHAR hp_tasks = 0;

// Bitfields used to represent low-priority tasks.
#define LP_TASK_1        (0x01)
#define LP_TASK_2        (0x02)

volatile K_UCHAR lp_tasks = 0;

// Interrupt sources, used to trigger both high and low priority tasks.
__interrupt__ System_Interrupt_1(void)
{
    // Set any of the other tasks from here...
    hp_tasks |= HP_TASK_1;
    // Trigger the SWI that calls the High_Priority_Tasks interrupt handler
    SWI();
}

__interrupt__ System_Interrupt_n...(void)
{
    // Set any of the other tasks from here...
}


// Interrupt handler that is used to implement the high-priority event context
__interrupt__ High_Priority_Tasks(void)
{
    // Enabled every interrupt except this one
    Disable_My_Interrupt();
    Enable_Interrupts();
    while( hp_tasks)
    {
        if( hp_tasks & HP_TASK_1)
        {
            HP_Task1();
            hp_tasks &= ~HP_TASK_1;
        }
        else if (hp_tasks & HP_TASK_2)
        {
            HP_Task2();
            hp_tasks &= ~HP_TASK_2;
        }
    }
    Restore_Interrupts();
    Enable_My_Interrupt();
}
```

```
// Main loop, used to implement the low-priority events
int main(void)
{
    // Set the function to run when a SWI is triggered
    Set_SWI(High_Priority_Tasks);

    // Run our super-loop
    while(1)
    {
        while (lp_tasks)
        {
            if (lp_tasks & LP_TASK_1)
            {
                LP_Task1();
                lp_tasks &= ~LP_TASK_1;
            }
            else if (lp_tasks & LP_TASK_2)
            {
                LP_Task2();
                lp_tasks &= ~LP_TASK_2;
            }
        }
        Idle();
    }
}
```

In this example, High_Priority_Tasks() can be triggered at any time as a result of a software interrupt (SWI),. When a high-priority event is set, the code that sets the event calls the SWI as well, which instantly preempts whatever is happening in main, switching to the high-priority interrupt handler. If the CPU is executing in an interrupt handler already, the current ISR completes, at which point control is given to the high priority interrupt handler.

Once inside the HP ISR, all interrupts (except the software interrupt) are re-enabled, which allows this interrupt to be preempted by other interrupt sources, which is called interrupt nesting. As a result, we end up with two distinct execution contexts (main and HighPriorityTasks()), in which all tasks in the high-priority group are guaranteed to preempt main() tasks, and will run to completion before returning control back to tasks in main(). This is a very basic preemptive multitasking scenario, approximating a "real" RTOS system with two threads of different priorities.

4.6 Problems with superloops

As mentioned earlier, a lot of real-world systems are implemented using a superloop design; and while they are simple to understand due to the limited and obvious control logic involved, they are not without their problems.

Hidden Costs

It's difficult to calculate the overhead of the superloop and the code required to implement workarounds for blocking calls, scheduling, and preemption. There's a cost in both the logic used to implement workarounds (usually involving state machines), as well as a cost to maintainability that comes with breaking up into chunks based on execution time instead of logical operations. In moderate firmware systems, this size cost can exceed the overhead of a reasonably well-featured RTOS, and the deficit in maintainability is something that is measurable in terms of lost productivity through debugging and profiling.

Tightly-coupled code

Because the control logic is integrated so closely with the application logic, a lot of care must be taken not to compromise the separation between application and system code. The timing loops, state machines, and architecture-specific control mechanisms used to avoid (or simulate) preemption can all contribute to the problem. As a result, a lot of superloop code ends up being difficult to port without effectively simulating or replicating the underlying system for which the application was written. Abstraction layers can mitigate the risks, but a lot of care should be taken to fully decouple the application code from the system code.

No blocking calls

In a super-loop environment, there's no such thing as a blocking call or blocking objects. Tasks cannot stop mid-execution for event-driven I/O from other contexts - they must always run to completion. If busy-waiting and polling are used as a substitute, it increases latency and wastes cycles. As a result, extra code complexity is often times necessary to work-around this lack of blocking objects, often times through implementing additional state machines. In a large enough system, the added overhead in code size and cycles can add up.

Difficult to guarantee responsiveness

Without multiple levels of priority, it may be difficult to guarantee a certain degree of real-time responsiveness without added profiling and tweaking. The latency of a given task in a priority-based cooperative multitasking system is the length of the longest task. Care must be taken to break tasks up into appropriate sized chunks in order to ensure that higher-priority tasks can run in a timely fashion - a manual process that must be repeated as new tasks are added in the system. Once again, this adds extra complexity that makes code larger, more difficult to understand and maintain due to the artificial subdivision of tasks into time-based components.

Limited preemption capability

As shown in the example code, the way to gain preemption in a superloop is through the use of nested interrupts. While this isn't unwiedly for two levels of priority, adding more levels beyond this is becomes complicated. In this case, it becomes necessary to track interrupt nesting manually, and separate sets of tasks that can run within given priority loops - and deadlock becomes more difficult to avoid.

Chapter 5

Mark3 Overview

5.1 Intro

The following section details the overall design of Mark3, the goals I've set out to achieve, the features that I've intended to provide, as well as an introduction to the programming concepts used to make it happen.

5.2 Features

Mark3 is a fully-featured real-time kernel, and is feature-competitive with other open-source and commercial RTOS's in the embedded arena.

The key features of this RTOS are:

- Flexible Scheduler
  - Unlimited number of threads with 8 priority levels
  - Unlimited threads per priority level
  - Round-robin scheduling for threads at each priority level
  - Time quantum scheduling for each thread in a given priority level
- Configurable stacks for each Thread
- Resource protection:
  - Integrated mutual-exclusion semaphores (Mutex)
  - Priority-inheritance on Mutex objects to prevent priority inversion
- Synchronization Objects
  - Binary and counting Semaphore to coordinate thread execution
- Efficient Timers
  - The RTOS is tickless, the OS only wakes up when a timer expires, not at a regular interval
  - One-shot and periodic timers with event callbacks
  - Timers are high-precision and long-counting (about 68000 seconds when used with a 16us resolution timer)
- Driver API
  - A hardware abstraction layer is provided to simplify driver development
- Robust Interprocess Communications
  - Threadsafe global Message pool and configurable message queues

5.3 Design Goals

Lightweight

Mark3 can be configured to have an extremely low static memory footprint. Each thread is defined with its own stack, and each thread structure can be configured to take as little as 26 bytes of RAM. The complete Mark3 kernel with all features, setup code, a serial driver, and the Mark3 protocol libraries comes in at under 9K of code space and 1K of RAM on atmel AVR.

Modular

Each system feature can be enabled or disabled by modifying the kernel configuration header file. Include what you want, and ignore the rest to save code space and RAM.

Easily Portable

Mark3 should be portable to a variety of 8, 16 and 32 bit architectures without MMUs. Porting the OS to a new architecture is relatively straightforward, requiring only device-specific implementations for the lowest-level operations such as context switching and timer setup.

Easy To Use

Mark3 is small by design - which gives it the advantage that it's also easy to develop for. This manual, the code itself, and the Doxygen documentation in the code provide ample documentation to get you up to speed quickly. Because you get to see the source, there's nothing left to assumption.

Simple to Understand

Not only is the Mark3 API rigorously documented (hey - that's what this book is for!), but the architecture and naming conventions are intuitive - it's easy to figure out where code lives, and how it works. Individual modules are small due to the "one feature per file" rule used in development. This makes Mark3 an ideal platform for learning about aspects of RTOS design.

Chapter 6

Getting Started

6.1 Kernel Setup

This section details the process of defining threads, initializing the kernel, and adding threads to the scheduler.

If you're at all familiar with real-time operating systems, then these setup and initialization steps should be familiar. I've tried very hard to ensure that as much of the heavy lifting is hidden from the user, so that only the bare minimum of calls are required to get things started.

The examples presented in this chapter are real, working examples taken from the ATmega328p port.

First, you'll need to create the necessary data structures and functions for the threads:

1. Create a Thread object for all of the "root" or "initial" tasks.
2. Allocate stacks for each of the Threads
3. Define an entry-point function for each Thread

This is shown in the example code below:

```
//-----------------------------------------------------------------------------
#include "thread.h"
#include "kernel.h"

//1) Create a thread object for all of the "root" or "initial" tasks
static Thread AppThread;
static Thread IdleThread;

//2) Allocate stacks for each thread
#define STACK_SIZE_APP      (192)
#define STACK_SIZE_IDLE     (128)

static K_UCHAR aucAppStack[STACK_SIZE_APP];
static K_UCHAR aucIdleStack[STACK_SIZE_IDLE];

//3) Define entry point functions for each thread
void AppThread(void);
void IdleThread(void);
```

Next, we'll need to add the required kernel initialization code to main. This consists of running the Kernel's init routine, initializing all of the threads we defined, adding the threads to the scheduler, and finally calling Kernel::-Start(), which transfers control of the system to the RTOS.

These steps are illustrated in the following example.

```
int main(void)
{
    //1) Initialize the kernel prior to use
    Kernel::Init();

    //2) Initialize all of the threads we've defined
```

```
    AppThread.Init( aucAppStack,
                    STACK_SIZE_APP,
                    1,
                    (void*)AppEntry,
                    NULL );

    IdleThread.Init( aucIdleStack,
                     STACK_SIZE_IDLE,
                     0,
                     4,
                     (void*)IdleEntry,
                     NULL );

    //3) Add the threads to the scheduler
    AppThread.Start();
    IdleThread.Start();

    //4) Give control of the system to the kernel
    Kernel::Start();
}
```

Not much to it, is there? There are a few noteworthy points in this code, though.

In order for the kernel to work properly, a system must always contain an idle thread; that is, a thread at priority level 0 that never blocks. This thread is responsible for performing any of the low-level power management on the CPU in order to maximize battery life in an embedded device. The idle thread must also never block, and it must never exit. Either of these operations will cause undefined behavior in the system.

The App thread is at a priority level greater-than 0. This ensures that as long as the App thread has something useful to do, it will be given control of the CPU. In this case, if the app thread blocks, control will be given back to the Idle thread, which will put the CPU into a power-saving mode until an interrupt occurs.

Stack sizes must be large enough to accommodate not only the requirements of the threads, but also the requirements of interrupts - up to the maximum interrupt-nesting level used. Stack overflows are super-easy to run into in an embedded system; if you encounter strange and unexplained behavior in your code, chances are good that one of your threads is blowing its stack.

6.2 Threads

Mark3 Threads act as independent tasks in the system. While they share the same address-space, global data, device-drivers, and system peripherals, each thread has its own set of CPU registers and stack, collectively known as the thread's **context**. The context is what allows the RTOS kernel to rapidly switch between threads at a high rate, giving the illusion that multiple things are happening in a system, when really, only one thread is executing at a time.

6.2.1 Thread Setup

Each instance of the Thread class represents a thread, its stack, its CPU context, and all of the state and metadata maintained by the kernel. Before a Thread will be scheduled to run, it must first be initialized with the necessary configuration data.

The Init function gives the user the opportunity to set the stack, stack size, thread priority, entry-point function, entry-function argument, and round-robin time quantum:

Thread stacks are pointers to blobs of memory (usually K_CHAR arrays) carved out of the system's address space. Each thread must have a stack defined that's large enough to handle not only the requirements of local variables in the thread's code path, but also the maximum depth of the ISR stack.

Priorities should be chosen carefully such that the shortest tasks with the most strict determinism requirements are executed first - and are thus located in the highest priorities. Tasks that take the longest to execute (and require the least degree of responsiveness) must occupy the lower thread priorities. The idle thread must be the only thread occupying the lowest priority level.

The thread quantum only aplies when there are multiple threads in the ready queue at the same priority level. This interval is used to kick-off a timer that will cycle execution between the threads in the priority list so that they each get a fair chance to execute.

The entry function is the function that the kernel calls first when the thread instance is first started. Entry functions have at most one argument - a pointer to a data-object specified by the user during initialization.

An example thread initailization is shown below:

```
Thread clMyThread;
K_UCHAR aucStack[192];

void AppEntry(void)
{
    while(1)
    {
        // Do something!
    }
}

...
{
    clMyThread.Init(aucStack,
                    192,
                    1,
                    4,
                    (void*)AppEntry,
                    NULL );

}
```

Once a thread has been initialized, it can be added to the scheduler by calling:

```
clMyThread.Start();
```

The thread will be placed into the Scheduler's queue at the designated priority, where it will wait its turn for execution.

6.2.2 Entry Functions

Mark3 Threads should not run-to-completion - they should execute as infinite loops that perform a series of tasks, appropriately partitioned to provide the responsiveness characteristics desired in the system.

The most basic Thread loop is shown below:

```
void Thread( void *param )
{
    while(1)
    {
        // Do Something
    }
}
```

Threads can interact with eachother in the system by means of synchronization objects (Semaphore), mutual-exclusion objects (Mutex), Inter-process messaging (MessageQueue), and timers (Timer).

Threads can suspend their own execution for a predetermined period of time by using the static Thread::Sleep() method. Calling this will block the Thread's executin until the amount of time specified has ellapsed. Upon expiry, the thread will be placed back into the ready queue for its priority level, where it awaits its next turn to run.

6.3 Timers

Timer objects are used to trigger callback events periodic or on a one-shot (alarm) basis.

While extremely simple to use, they provide one of the most powerful execution contexts in the system. The timer callbacks execute from within the timer callback ISR in an interrupt-enabled context. As such, timer callbacks are considered higher-priority than any thread in the system, but lower priority than other interrupts. Care must be taken to ensure that timer callbacks execute as quickly as possible to minimize the impact of processing on the throughput of tasks in the system. Wherever possible, heavy-lifting should be deferred to the threads by way of semaphores or messages.

Below is an example showing how to start a periodic system timer which will trigger every second:

```
{
    Timer clTimer;
    clTimer.Init();

    clTimer.Start( 1000,
                   1,
                   MyCallback,
                   (void*)&my_data );

    ... // Keep doing work in the thread
}

// Callback function, executed from the timer-expiry context.
void MyCallBack( Thread *pclOwner_, void *pvData_ )
{
    LED.Flash(); // Flash an LED.
}
```

6.4 Semaphores

Semaphores are used to synchronized execution of threads based on the availability (and quantity) of application-specific resources in the system. They are extremely useful for solving producer-consumer problems, and are the method-of-choice for creating efficient, low latency systems, where ISRs post semaphores that are handled from within the context of individual threads. (Yes, Semaphores can be posted - but not pended - from the interrupt context).

The following is an example of the producer-consumer usage of a binary semaphore:

```
Semaphore clSemaphore; // Declare a semaphore shared between a producer and a consumer thread.

void Producer()
{
    clSemaphore.Init(0, 1);
    while(1)
    {
        // Do some work, create something to be consumed

        // Post a semaphore, allowing another thread to consume the data
        clSemaphore.Post();
    }
}

void Consumer()
{
    // Assumes semaphore initialized before use...
    While(1)
    {
        // Wait for new data from the producer thread
        clSemaphore.Pend();

        // Consume the data!
    }
}
```

And an example of using semaphores from the ISR context to perform event- driven processing.

```
Semaphore clSemaphore;

__interrupt__ MyISR()
{
    clSemaphore.Post(); // Post the interrupt.  Lightweight when uncontested.
}

void MyThread()
{
    clSemaphore.Init(0, 1); // Ensure this is initialized before the MyISR interrupt is enabled.
    while(1)
    {
        // Wait until we get notification from the interrupt
        clSemaphore.Pend();

        // Interrupt has fired, do the necessary work in this thread's context
        HeavyLifting();
    }
}
```

6.5 Mutexes

Mutexes (Mutual exclusion objects) are provided as a means of creating "protected sections" around a particular resource, allowing for access of these objects to be serialized. Only one thread can hold the mutex at a time - other threads have to wait until the region is released by the owner thread before they can take their turn operating on the protected resource. Note that mutexes can only be owned by threads - they are not available to other contexts (i.e. interrupts). Calling the mutex APIs from an interrupt will cause catastrophic system failures.

Note that these objects are also not recursive- that is, the owner thread can not attempt to claim a mutex more than once.

Prioritiy inheritence is provided with these objects as a means to avoid prioritiy inversions. Whenever a thread at a priority than the mutex owner blocks on a mutex, the priority of the current thread is boosted to the highest-priority waiter to ensure that other tasks at intermediate priorities cannot artificically prevent progress from being made.

Mutex objects are very easy to use, as there are only three operations supported: Initialize, Claim and Release. An example is shown below.

```
Mutex clMutex;  // Create a mutex globally.

void Init()
{
    // Initialize the mutex before use.
    clMutex.Init();
}

// Some function called from a thread
void Thread1Function()
{
    clMutex.Claim();

    // Once the mutex is owned, no other thread can
    // enter a block protect by the same mutex

    my_protected_resource.do_something();
    my_protected_resource.do_something_else();

    clMutex.Release();
}

// Some function called from another thread
void Thread2Function()
{
    clMutex.Claim();

    // Once the mutex is owned, no other thread can
    // enter a block protect by the same mutex

    my_protected_resource.do_something();
    my_protected_resource.do_different_things();

    clMutex.Release();
}
```

6.6 Messages

Sending messages between threads is the key means of synchronizing access to data, and the primary mechanism to perform asynchronous data processing operations.

Sending a message consists of the following operations:

- Obtain a Message object from the global message pool
- Set the message data and event fields
- Send the message to the destination message queue

While receiving a message consists of the following steps:

- Wait for a messages in the destination message queue

- Process the message data
- Return the message back to the global message pool

These operations, and the various data objects involved are discussed in more detail in the following section.

6.6.1 Message Objects

Message objects are used to communicate arbitrary data between threads in a safe and synchronous way.

The message object consists of an event code field and a data field. The event code is used to provide context to the message object, while the data field (essentially a void * data pointer) is used to provide a payload of data corresponding to the particular event.

Access to these fields is marshalled by accessors - the transmitting thread uses the SetData() and SetCode() methods to seed the data, while the receiving thread uses the GetData() and GetCode() methods to retrieve it.

By providing the data as a void data pointer instead of a fixed-size message, we achieve an unprecedented measure of simplicity and flexibility. Data can be either statically or dynamically allocated, and sized appropriately for the event without having to format and reformat data by both sending and receiving threads. The choices here are left to the user - and the kernel doesn't get in the way of efficiency.

It is worth noting that you can send messages to message queues from within ISR context. This helps maintain consistency, since the same APIs can be used to provide event-driven programming facilities throughout the whole of the OS.

6.6.2 Global Message Pool

To maintain efficiency in the messaging system (and to prevent over-allocation of data), a global pool of message objects is provided. The size of this message pool is specified in the implementation, and can be adjusted depending on the requirements of the target application as a compile-time option.

Allocating a message from the message pool is as simple as calling the GlobalMessagePool::Pop() Method.

Messages are returned back to the GlobalMessagePool::Push() method once the message contents are no longer required.

One must be careful to ensure that discarded messages always are returned to the pool, otherwise a resource leak can occur, which may cripple the operating system's ability to pass data between threads.

6.6.3 Message Queues

Message objects specify data with context, but do not specify where the messages will be sent. For this purpose we have a MessageQueue object. Sending an object to a message queue involves calling the MessageQueue::Send() method, passing in a pointer to the Message object as an argument.

When a message is sent to the queue, the first thread blocked on the queue (as a result of calling the MessageQueue Receive() method) will wake up, with a pointer to the Message object returned.

It's worth noting that multiple threads can block on the same message queue, providing a means for multiple threads to share work in parallel.

6.6.4 Messaging Example

```
// Message queue object shared between threads
MessageQueue clMsgQ;

// Function that initializes the shared message queue
void MsgQInit()
{
    clMsgQ.Init();
}
```

```
// Function called by one thread to send message data to
// another
void TxMessage()
{
    // Get a message, initialize its data
    Message *pclMesg = GlobalMessagePool::Pop();

    pclMesg->SetCode(0xAB);
    pclMesg->SetData((void*)some_data);

    // Send the data to the message queue
    clMsgQ.Send(pclMesg);
}

// Function called in the other thread to block until
// a message is received in the message queue.
void RxMessage()
{
    Message *pclMesg;

    // Block until we have a message in the queue
    pclMesg = clMsgQ.Receive();

    // Do something with the data once the message is received
    pclMesg->GetCode();

    // Free the message once we're done with it.
    GlobalMessagePool::Push(pclMesg);
}
```

6.7 Sleep

There are instances where it may be necessary for a thread to poll a resource, or wait a specific amount of time before proceeding to operate on a peripheral or volatile piece of data.

While the Timer object is generally a better choice for performing time-sensitive operations (and certainly a better choice for periodic operations), the Thread::Sleep() method provides a convenient (and efficient) mechanism that allows for a thread to suspend its execution for a specified interval.

Note that when a thread is sleeping it is blocked, during which other threads can operate, or the system can enter its idle state.

```
int GetPeripheralData();
{
    int value;
    // The hardware manual for a peripheral specifies that
    // the "foo()" method will result in data being generated
    // that can be captured using the "bar()" method.
    // However, the value only becomes valid after 10ms

    peripheral.foo();
    Thread::Sleep(10);  // Wait 10ms for data to become valid
    value = peripheral.bar();
    return value;
}
```

6.8 Round-Robin Quantum

Threads at the same thread priority are scheduled using a round-robin scheme. Each thread is given a timeslice (which can be configured) of which it shares time amongst ready threads in the group. Once a thread's timeslice has expired, the next thread in the priority group is chosen to run until its quantum has expired - the cycle continues over and over so long as each thread has work to be done.

By default, the round-robin interval is set at 4ms.

This value can be overridden by calling the thread's SetQuantum() with a new interval specified in milliseconds.

Chapter 7

Build System

Mark3 is distributed with a recursive makefile build system, allowing the entire source tree to be built into a series of libraries with simple make commands.

The way the scripts work, every directory with a valid makefile is scanned, as well as all of its subdirectories. The build then generates binary components for all of the components it finds -libraries and executables. All libraries that are generated can then be imported into an application using the linker without having to copy-and-paste files on a module-by-module basis. Applications built during this process can then be loaded onto a device directly, without requiring a GUI-based IDE. As a result, Mark2 integrates well with 3rd party tools for continuous-integration and automated testing.

This modular framework allows for large volumes of libraries and binaries to be built at once - the default build script leverages this to build all of the examples and unit tests at once, linking against the pre-built kernel, services, and drivers. Whatever can be built as a library is built as a library, promoting reuse throughout the platform, and enabling Mark3 to be used as a platform, with an ecosystem of libraries, services, drivers and applications.

7.1 Source Layout

One key aspect of Mark2 is that system features are organized into their own separate modules. These modules are further grouped together into folders based on the type of features represented:

```
Root            Base folder, contains recursive makefiles for build system
    bootloader  Mark2 Bootloader code for AVR
    build       Makefile support for various platforms
    doc         Documentation (including this)
    drivers     Device driver code
    example     Example applications
    kernel      Basic Mark2 Components (the focus of this manual)
        cpu     CPU-specific porting code
    services    Utility code and services, extended system features
    stage       Staging directory, where the build system places artifacts
    tests       Unit tests, written as C/C++ applications
```

7.2 Building the kernel

The base.mak file determines how the kernel, drivers, and libraries are built, for what targets, and with what options. Most of these options can be copied directly from the options found in your IDE managed projects. Below is an overview of the main variables used to configure the build.

```
STAGE       - Location in the filesystem where the build output is stored
ROOT_DIR    - The location of the root source tree
ARCH        - The CPU architecture to build against
VARIANT     - The variant of the above CPU to target
TOOLCHAIN   - Which toolchain to build with (dependent on ARCH and VARIANT)
```

Build.mak contains the logic which is used to perform the recursive make in all directories. Unless you really know what you're doing, it's best to leave this as-is.

You must make sure that all required paths are set in your system environment variables so that they are accessible through from the command-line.

Once configured, you can build the source tree using the various make targets:

- make headers
  - copy all headers in each module's /public subdirectory to the location specified by STAGE environment variable's ./inc subdirectory.
- make library
  - regenerate all objects copy marked as libraries (i.e. the kernel + drivers). Resulting binaries are copied into STAGE's ./lib subdirectory.
- make binary
  - build all executable projects in the root directory structure. In the default distribution, this includes the basic set of demos.

To add new components to the recursive build system, simply add your code into a new folder beneath the root install location.

Source files, the module makefile and private header files go directly in the new folder, while public headers are placed in a ./public subdirectory. Create a ./obj directory to hold the output from the builds.

The contents of the module makefile looks something like this:

```
# Include common prelude make file
include $(ROOT_DIR)base.mak

# If we're building a library, set IS_LIB and LIBNAME
# If we're building an app, set IS_APP and APPNAME
IS_LIB=1
LIBNAME=mylib

#this is the list of the source modules required to build the kernel
CPP_SOURCE = mylib.cpp \
             someotherfile.cpp

# Similarly, C-language source would be under the C_SOURCE variable.

# Include the rest of the script that is actually used for building the
# outputs
include $(ROOT_DIR)build.mak
```

Once you've placed your code files in the right place, and configured the makefile appropriately, a fresh call to make headers, make library, then make binary will guarantee that your code is built.

Now, you can still copy-and-paste the required kernel, port, and drivers, directly into your application avoiding the whole process of using make from the command line. To do this, run "make source" from the root directory in svn, and copy the contents of /stage/src into your project. This should contain the source to the kernel, all drivers, and all services that are in the tree - along with the necessary header files.

Chapter 8

License

8.1 License

Chapter 9

Profiling Results

The following profiling results were obtained using an ATMega328p @ 16MHz.

The test cases are designed to make use of the kernel profiler, which accurately measures the performance of the fundamental system APIs, in order to provide information for user comparison, as well as to ensure that regressions are not being introduced into the system.

9.1 Date Performed

Sat Jun 1 10:43:06 EDT 2013

9.2 Compiler Information

The kernel and test code used in these results were built using the following compiler: ./profile.sh: 55: ./profile.sh: /home/moslevin/atmel/bin/avr-gcc: not found

9.3 Profiling Results

- Semaphore Initialization: 7 cycles (averaged over 83 iterations)
- Semaphore Post (uncontested): 180 cycles (averaged over 83 iterations)
- Semaphore Pend (uncontested): 67 cycles (averaged over 83 iterations)
- Semaphore Flyback Time (Contested Pend): 1553 cycles (averaged over 83 iterations)
- Mutex Init: 0 cycles (averaged over 83 iterations)
- Mutex Claim: 143 cycles (averaged over 83 iterations)
- Mutex Release: 49 cycles (averaged over 83 iterations)
- Thread Initialize: 7800 cycles (averaged over 83 iterations)
- Thread Start: 803 cycles (averaged over 83 iterations)
- Context Switch: 198 cycles (averaged over 83 iterations)
- Thread Schedule: 47 cycles (averaged over 83 iterations)

Chapter 10

Hierarchical Index

10.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

Chapter 11

Class Index

11.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 12

File Index

12.1 File List

Here is a list of all documented files with brief descriptions:

Chapter 13

Class Documentation

13.1 BlockHeap Class Reference

Single-block-size heap.

`#include <fixed_heap.h>`

Public Member Functions

- void * Create (void *pvHeap_, K_USHORT usSize_, K_USHORT usBlockSize_)

  Create a single list heap in the blob of memory provided, with the selected heap size, and the selected number of blocks.
- void * Alloc ()

  Allocate a block of memory from this heap.
- void Free (void *pvData_)

  Free a previously allocated block of memory.
- K_BOOL IsFree ()

  Returns the state of a heap - whether or not it has free elements.

Protected Attributes

- K_USHORT m_usBlocksFree

  Number of blocks free in the heap.

Private Attributes

- DoubleLinkList m_clList

  Linked list used to manage the blocks.

13.1.1 Detailed Description

Single-block-size heap.

Definition at line 29 of file fixed_heap.h.

13.1.2 Member Function Documentation

13.1.2.1 void * BlockHeap::Alloc ( )

Allocate a block of memory from this heap.

Returns

pointer to a block of memory, or 0 on failure

Definition at line 83 of file fixed_heap.cpp.

13.1.2.2 void * BlockHeap::Create (void * *pvHeap_*, K_USHORT *usSize_*, K_USHORT *usBlockSize_*)

Create a single list heap in the blob of memory provided, with the selected heap size, and the selected number of blocks.

Will create as many blocks as will fit in the usSize_ parameter

Parameters

*pvHeap_*	Pointer to the heap data to initialize
*usSize_*	Size of the heap range in bytes
*usBlockSize_*	Size of each heap block in bytes

Returns

Pointer to the next heap element to initialize

Definition at line 48 of file fixed_heap.cpp.

13.1.2.3 void BlockHeap::Free (void * *pvData_*)

Free a previously allocated block of memory.

Parameters

*pvData_*	Pointer to a block of data previously allocated off the heap.

Definition at line 102 of file fixed_heap.cpp.

13.1.2.4 K_BOOL BlockHeap::IsFree ( ) [inline]

Returns the state of a heap - whether or not it has free elements.

Returns

true if the heap is not full, false if the heap is full

Definition at line 74 of file fixed_heap.h.

The documentation for this class was generated from the following files:

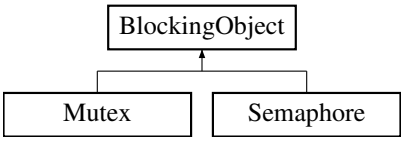
- /home/moslevin2/mark3/embedded/stage/src/fixed_heap.h
- /home/moslevin2/mark3/embedded/stage/src/fixed_heap.cpp

13.2 BlockingObject Class Reference

Class implementing thread-blocking primatives.

`#include <blocking.h>`

Inheritance diagram for BlockingObject:



Protected Member Functions

- void Block (Thread *pclThread_)
- void UnBlock (Thread *pclThread_)

Protected Attributes

- ThreadList m_clBlockList

  ThreadList which is used to hold the list of threads blocked on a given object.

13.2.1 Detailed Description

Class implementing thread-blocking primatives.

Used for implementing things like semaphores, mutexes, message queues, or anything else that could cause a thread to suspend execution on some external stimulus.

Definition at line 65 of file blocking.h.

13.2.2 Member Function Documentation

13.2.2.1 void BlockingObject::Block (Thread * *pclThread_*) [protected]

Parameters

*pclThread_*	Pointer to the thread object that will be blocked.

Blocks a thread on this object. This is the fundamental operation performed by any sort of blocking operation in the operating system. All semaphores/mutexes/sleeping/messaging/etc ends up going through the blocking code at some point as part of the code that manages a transition from an "active" or "waiting" thread to a "blocked" thread.

The steps involved in blocking a thread (which are performed in the function itself) are as follows;

1) Remove the specified thread from the current owner's list (which is likely one of the scheduler's thread lists) 2) Add the thread to this object's thread list 3) Setting the thread's "current thread-list" point to reference this object's threadlist.

Definition at line 36 of file blocking.cpp.

13.2.2.2 void BlockingObject::UnBlock (Thread * *pclThread_*) [protected]

Parameters

*pclThread_*	Pointer to the thread to unblock.

Unblock a thread that is already blocked on this object, returning it to the "ready" state by performing the following steps:

1) Removing the thread from this object's threadlist 2) Restoring the thread to its "original" owner's list

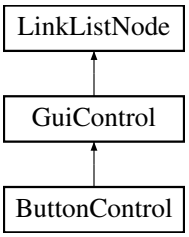
Definition at line 52 of file blocking.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/blocking.h
- /home/moslevin2/mark3/embedded/stage/src/blocking.cpp

13.3 ButtonControl Class Reference

Inheritance diagram for ButtonControl:



Public Member Functions

- virtual void Init ()

  Initiailize the control - must be called before use.
- virtual void Draw ()

  Redraw the control "cleanly".
- virtual GuiReturn_t ProcessEvent (GuiEvent_t *pstEvent_)

  Process an event sent to the control.
- virtual void Activate (bool bActivate_)

  Activate or deactivate the current control - used when switching from one active control to another.
- void **SetBGColor** (COLOR eColor_)
- void **SetLineColor** (COLOR eColor_)
- void **SetFillColor** (COLOR eColor_)
- void **SetTextColor** (COLOR eColor_)
- void **SetActiveColor** (COLOR eColor_)
- void **SetFont** (Font_t *pstFont_)
- void **SetCaption** (const K_CHAR *szCaption_)
- void **SetCallback** (ButtonCallback pfCallback_, void *pvData_)

Private Attributes

- const K_CHAR * **m_szCaption**
- Font_t * **m_pstFont**
- COLOR **m_uBGColor**
- COLOR **m_uActiveColor**
- COLOR **m_uLineColor**

- COLOR **m_uFillColor**
- COLOR **m_uTextColor**
- bool **m_bState**
- void * **m_pvCallbackData**
- ButtonCallback **m_pfCallback**

Additional Inherited Members

13.3.1 Detailed Description

Definition at line 32 of file control_button.h.

13.3.2 Member Function Documentation

13.3.2.1 void ButtonControl::Activate (bool *bActivate_*) [virtual]

Activate or deactivate the current control - used when switching from one active control to another.

Parameters

*bActivate_*	- true to activate, false to deactivate

Implements GuiControl.

Definition at line 215 of file control_button.cpp.

13.3.2.2 void ButtonControl::Draw ( ) [virtual]

Redraw the control "cleanly".

Subclass specific.

Implements GuiControl.

Definition at line 39 of file control_button.cpp.

13.3.2.3 void ButtonControl::Init ( ) [virtual]

Initiailize the control - must be called before use.

Implementation is subclass specific.

Implements GuiControl.

Definition at line 25 of file control_button.cpp.

13.3.2.4 GuiReturn_t ButtonControl::ProcessEvent (GuiEvent_t * *pstEvent_*) [virtual]

Process an event sent to the control.

Subclass specific implementation.

Parameters

*pstEvent_*	Pointer to a struct containing the event data

Implements GuiControl.

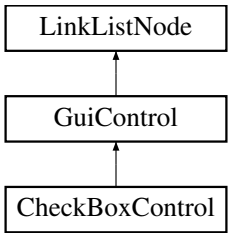
Definition at line 117 of file control_button.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/control_button.h
- /home/moslevin2/mark3/embedded/stage/src/control_button.cpp

13.4 CheckBoxControl Class Reference

Inheritance diagram for CheckBoxControl:



Public Member Functions

- virtual void Init ()

  Initiailize the control - must be called before use.
- virtual void Draw ()

  Redraw the control "cleanly".
- virtual GuiReturn_t ProcessEvent (GuiEvent_t *pstEvent_)

  Process an event sent to the control.
- virtual void Activate (bool bActivate_)

  Activate or deactivate the current control - used when switching from one active control to another.
- void **SetFont** (Font_t *pstFont_)
- void **SetCaption** (const char *szCaption_)
- void **SetCheck** (bool bChecked_)
- void **SetFontColor** (COLOR uFontColor_)
- void **SetBoxColor** (COLOR uBoxColor_)
- void **SetBackColor** (COLOR uBackColor_)
- bool **IsChecked** (void)

Private Attributes

- const char * **m_szCaption**
- COLOR **m_uBackColor**
- COLOR **m_uBoxColor**
- COLOR **m_uFontColor**
- Font_t * **m_pstFont**
- bool **m_bChecked**

Additional Inherited Members

13.4.1 Detailed Description

Definition at line 29 of file control_checkbox.h.

13.4.2 Member Function Documentation

13.4.2.1 virtual void CheckBoxControl::Activate (bool *bActivate_*) [inline], [virtual]

Activate or deactivate the current control - used when switching from one active control to another.

Parameters

*bActivate_*	- true to activate, false to deactivate

Implements GuiControl.

Definition at line 35 of file control_checkbox.h.

13.4.2.2 void CheckBoxControl::Draw ( ) [virtual]

Redraw the control "cleanly".

Subclass specific.

Implements GuiControl.

Definition at line 59 of file control_checkbox.cpp.

13.4.2.3 void CheckBoxControl::Init ( ) [virtual]

Initiailize the control - must be called before use.

Implementation is subclass specific.

Implements GuiControl.

Definition at line 53 of file control_checkbox.cpp.

13.4.2.4 GuiReturn_t CheckBoxControl::ProcessEvent (GuiEvent_t * *pstEvent_*) [virtual]

Process an event sent to the control.

Subclass specific implementation.

Parameters

*pstEvent_*	Pointer to a struct containing the event data

Implements GuiControl.

Definition at line 130 of file control_checkbox.cpp.

The documentation for this class was generated from the following files:

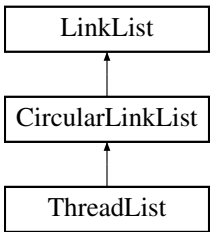
- /home/moslevin2/mark3/embedded/stage/src/control_checkbox.h
- /home/moslevin2/mark3/embedded/stage/src/control_checkbox.cpp

13.5 CircularLinkList Class Reference

Circular-linked-list data type, inherited from the base LinkList type.

`#include <ll.h>`

Inheritance diagram for CircularLinkList:



Public Member Functions

- virtual void Add (LinkListNode *node_)

  Add the linked list node to this linked list.
- virtual void Remove (LinkListNode *node_)

  Add the linked list node to this linked list.
- void PivotForward ()

  Pivot the head of the circularly linked list forward (Head = Head->next, Tail = Tail->next)
- void PivotBackward ()

  Pivot the head of the circularly linked list backward (Head = Head->prev, Tail = Tail->prev)

Additional Inherited Members

13.5.1 Detailed Description

Circular-linked-list data type, inherited from the base LinkList type.

Definition at line 201 of file ll.h.

13.5.2 Member Function Documentation

13.5.2.1 void CircularLinkList::Add (LinkListNode * *node_*) [virtual]

Add the linked list node to this linked list.

Parameters

*node_*	Pointer to the node to add

Implements LinkList.

Reimplemented in ThreadList.

Definition at line 89 of file ll.cpp.

13.5.2.2 void CircularLinkList::Remove (LinkListNode * *node_*) [virtual]

Add the linked list node to this linked list.

Parameters

*node_*	Pointer to the node to remove

Implements LinkList.

Reimplemented in ThreadList.

Definition at line 114 of file ll.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/ll.h
- /home/moslevin2/mark3/embedded/stage/src/ll.cpp

13.6 CommandLine_t Struct Reference

Structure containing multiple representations for command-line data.

`#include <shell_support.h>`

Public Attributes

- Token_t * pastTokenList

  Pointer to the list of tokens in the commandline.
- K_UCHAR ucTokenCount

  Count of tokens in the token list.
- Token_t * pstCommand

  Pointer to the token corresponding to the shell command.
- Option_t astOptions [12]

  Option strucure array built from the token list.
- K_UCHAR ucNumOptions

  Number of options parsed from the token list.

13.6.1 Detailed Description

Structure containing multiple representations for command-line data.

Definition at line 93 of file shell_support.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/shell_support.h

13.7 DCPU Class Reference

DCPU emulator, used for running code out of EEPROM, RAM, or other memory interfaces than FLASH.

`#include <dcpu.h>`

Public Member Functions

- void Init (K_USHORT *pusRAM_, K_USHORT usRAMSize_, const K_USHORT *pusROM_, K_USHORT usROMSize_)

  Initialize the CPU emulator, specifying which driver supplies the memory read interface.
- void RunOpcode ()

  Execute the next opcode at the VM's current PC.
- DCPU_Registers * GetRegisters ()

  Return a pointer to the VM's register structure.
- void SendInterrupt (K_USHORT usMessage_)

  Send an interrupt to the CPU with a given message.
- void AddPlugin (DCPUPlugin *pclPlugin_)

  Add a plugin to the CPU.

Private Member Functions

- void **SET** ()
- void **ADD** ()
- void **SUB** ()
- void **MUL** ()
- void **MLI** ()
- void **DIV** ()
- void **DVI** ()
- void **MOD** ()
- void **MDI** ()
- void **AND** ()
- void **BOR** ()
- void **XOR** ()
- void **SHR** ()
- void **ASR** ()
- void **SHL** ()
- bool **IFB** ()
- bool **IFC** ()
- bool **IFE** ()
- bool **IFN** ()
- bool **IFG** ()
- bool **IFA** ()
- bool **IFL** ()
- bool **IFU** ()
- void **ADX** ()
- void **SBX** ()
- void **STI** ()
- void **STD** ()
- void **JSR** ()
- void **INT** ()
- void **IAG** ()
- void **IAS** ()
- void RFI ()
- void IAQ ()
- void HWN ()
- void **HWQ** ()
- void **HWI** ()
- K_UCHAR GetOperand (K_UCHAR ucOpType_, K_USHORT **pusResult_)
- void ProcessInterruptQueue ()

  Process the next interrupt in the Queue.

Private Attributes

- DCPU_Registers m_stRegisters

  CPU Register file.
- K_USHORT * a

  Temporary "a" operand pointer.
- K_USHORT * b

  Temporary "b" operand pointer.
- K_USHORT m_usTempA

  Local-storage for staging literal "a" values.
- K_USHORT * m_pusRAM

Pointer to the RAM buffer.

- K_USHORT m_usRAMSize

  Size to the RAM (including stack)

- K_USHORT * m_pusROM

  Pointer to the CPU ROM storage.

- K_USHORT m_usROMSize

  Size of the ROM.

- K_ULONG m_ulCycleCount

  Current cycle count.

- K_BOOL m_bInterruptQueueing

  CPU flag indicating whether or not interrupts are queued.

- K_UCHAR m_ucQueueLevel

  Current interrupt Queue level.

- K_USHORT m_ausInterruptQueue [8]

  Interrupt queue.

- DoubleLinkList m_clPluginList

  Linked-list of plug-ins.

13.7.1 Detailed Description

DCPU emulator, used for running code out of EEPROM, RAM, or other memory interfaces than FLASH.

Definition at line 359 of file dcpu.h.

13.7.2 Member Function Documentation

13.7.2.1 void DCPU::AddPlugin (DCPUPlugin * *pclPlugin_*)

Add a plugin to the CPU.

Parameters

*pclPlugin_*	Pointer to the plugin object to add

Definition at line 940 of file dcpu.cpp.

13.7.2.2 K_UCHAR DCPU::GetOperand (K_UCHAR *ucOpType_*, K_USHORT ** *pusResult_*) [private]

Parameters

*ucOpType_*	The operand type, as specified in DCPU_Argument
*pusResult_*	Pointer to the pointer that corresponds to the argument's location in memory.

Definition at line 717 of file dcpu.cpp.

13.7.2.3 DCPU_Registers * DCPU::GetRegisters ( ) [inline]

Return a pointer to the VM's register structure.

Returns

Pointer to the VM's register structure

Definition at line 391 of file dcpu.h.

13.7.2.4 void DCPU::HWN ( ) [private]

Returns the number of connected hardware devices to "a"

Definition at line 637 of file dcpu.cpp.

13.7.2.5 void DCPU::IAQ ( ) [private]

Add an interrupt to the interrupt queue if non-zero, if a = 0 then interrupts will be triggered as normal

Interrupts queued

Interrups triggered

Definition at line 619 of file dcpu.cpp.

13.7.2.6 void DCPU::Init (K_USHORT * *pusRAM_*, K_USHORT *usRAMSize_*, const K_USHORT * *pusROM_*, K_USHORT *usROMSize_*)

Initialize the CPU emulator, specifying which driver supplies the memory read interface.

This allows us to abstract RAM/FLASH/EEPROM or other memory. The VM must be initialized before any other method in the class is run.

Parameters

*pusRAM_*	Pointer to the CPU's RAM buffer
*usRAMSize_*	Size of the RAM Buffer in words
*pusROM_*	Pointer to the CPU's ROM buffer
*usROMSize_*	Size of the ROM buffer in words

Definition at line 692 of file dcpu.cpp.

13.7.2.7 void DCPU::RFI ( ) [private]

Disables interrupt queueing, pop A from the stack, then pops PC from the stack. By disabling interrupt Queueing, we're essentially re-enabling interrupts.

Definition at line 604 of file dcpu.cpp.

13.7.2.8 void DCPU::SendInterrupt (K_USHORT *usMessage_*)

Send an interrupt to the CPU with a given message.

Parameters

*usMessage_*	Message to send along with the interrupt

Definition at line 914 of file dcpu.cpp.

13.7.3 Member Data Documentation

13.7.3.1 DoubleLinkList DCPU::m_clPluginList [private]

Linked-list of plug-ins.

Definition at line 489 of file dcpu.h.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/dcpu.h
- /home/moslevin2/mark3/embedded/stage/src/dcpu.cpp

13.8 DCPU_Registers Struct Reference

Structure defining the DCPU hardware registers.

`#include <dcpu.h>`

Public Attributes

- union {
  struct {
  K_USHORT **A**
  K_USHORT **B**
  K_USHORT **C**
  K_USHORT **X**
  K_USHORT **Y**
  K_USHORT **Z**
  K_USHORT **I**
  K_USHORT **J**
  K_USHORT **PC**
  K_USHORT **SP**
  K_USHORT **EX**
  K_USHORT **IA**
  }
  K_USHORT **ausRegisters** [12]
  };

13.8.1 Detailed Description

Structure defining the DCPU hardware registers.

Definition at line 72 of file dcpu.h.

The documentation for this struct was generated from the following file:

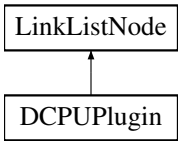
- /home/moslevin2/mark3/embedded/stage/src/dcpu.h

13.9 DCPUPlugin Class Reference

Class used to provide the hardware device abstraction between the DCPU-16 emulator/VM and the host system.

`#include <dcpu.h>`

Inheritance diagram for DCPUPlugin:



Public Member Functions

- void Init (K_USHORT usDeviceNumber_, K_ULONG ulHWID_, K_ULONG ulVID_, K_USHORT usVersion_, DCPU_Callback pfCallback_)

  Initialize the DCPU plugin extension.
- void Enumerate (DCPU_Registers *pstRegisters_)

  Perform hardware enumeration to the target VM specified by the register set.
- void Interrupt (DCPU *pclCPU_)

  Execute the hardware callback.
- K_USHORT GetDeviceNumber ()

  Return the device number associated with this plugin.

Private Attributes

- K_USHORT m_usDeviceNumber

  Location of the device on the "bus".
- K_ULONG m_ulHWID

  Hardware ID.
- K_ULONG m_ulVID

  Vendor ID.
- K_USHORT m_usVersion

  Hardware Version.
- DCPU_Callback m_pfCallback

  HWI Callback.

Friends

- class **DCPUPluginList**

Additional Inherited Members

13.9.1 Detailed Description

Class used to provide the hardware device abstraction between the DCPU-16 emulator/VM and the host system.

Definition at line 267 of file dcpu.h.

13.9.2 Member Function Documentation

13.9.2.1 void DCPUPlugin::Enumerate (DCPU_Registers * *pstRegisters_*) [inline]

Perform hardware enumeration to the target VM specified by the register set.

Parameters

*pstRegisters_*	Pointer to the VM's CPU registers, which are filled with enumeration data. See the DCPU 1.7 spec for details.

Definition at line 311 of file dcpu.h.

13.9.2.2 K_USHORT DCPUPlugin::GetDeviceNumber ( ) [inline]

Return the device number associated with this plugin.

Returns

Device number associated with this plugin

Definition at line 339 of file dcpu.h.

13.9.2.3 void DCPUPlugin::Init (K_USHORT *usDeviceNumber_*, K_ULONG *ulHWID_*, K_ULONG *ulVID_*, K_USHORT *usVersion_*, DCPU_Callback *pfCallback_*) [inline]

Initialize the DCPU plugin extension.

Plug

Parameters

*usDeviceNumber_*	Unique plugin device enumeration associated with this plugin
*ulHWID_*	Unique hardware type identifier
*ulVID_*	Hardware Vendor ID
*usVersion_*	Version identifier for this hardware piece
*pfCallback_*	Callback function invoked from the VM when a HWI instruction is called on this device. This is essentially the interrupt handler.

Definition at line 288 of file dcpu.h.

13.9.2.4 void DCPUPlugin::Interrupt (DCPU * *pclCPU_*) [inline]

Execute the hardware callback.

Parameters

*pclCPU_*	Pointer to the VM triggering the interrupt

Definition at line 327 of file dcpu.h.

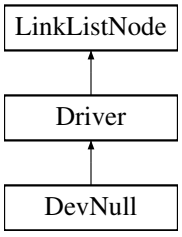
The documentation for this class was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/dcpu.h

13.10 DevNull Class Reference

This class implements the "default" driver (/dev/null)

Inheritance diagram for DevNull:



Public Member Functions

- virtual void Init ()

  Initialize a driver, must be called prior to use.
- virtual K_UCHAR Open ()

  Open a device driver prior to use.
- virtual K_UCHAR Close ()

  Close a previously-opened device driver.
- virtual K_USHORT Read (K_USHORT usBytes_, K_UCHAR *pucData_)

  Read a specified number of bytes from the device into a specific buffer.
- virtual K_USHORT Write (K_USHORT usBytes_, K_UCHAR *pucData_)

  Write a payload of data of a given length to the device.
- virtual K_USHORT Control (K_USHORT usEvent_, void *pvDataIn_, K_USHORT usSizeIn_, void *pvDataOut_, K_USHORT usSizeOut_)

  This is the main entry-point for device-specific io and control operations.

Additional Inherited Members

13.10.1 Detailed Description

This class implements the "default" driver (/dev/null)

Definition at line 40 of file driver.cpp.

13.10.2 Member Function Documentation

13.10.2.1 virtual K_UCHAR DevNull::Close ( ) [inline], [virtual]

Close a previously-opened device driver.

Returns

Driver-specific return code, 0 = OK, non-0 = error

Implements Driver.

Definition at line 45 of file driver.cpp.

13.10.2.2 virtual K_USHORT DevNull::Control (K_USHORT *usEvent_*, void * *pvDataIn_*, K_USHORT *usSizeIn_*, void * *pvDataOut_*, K_USHORT *usSizeOut_*) [inline], [virtual]

This is the main entry-point for device-specific io and control operations.

This is used for implementing all "side-channel" communications with a device, and any device-specific IO operations that do not conform to the typical POSIX read/write paradigm. Use of this funciton is analagous to the non-POSIX (yet still common) devctl() or ioctl().

Parameters

*usEvent_*	Code defining the io event (driver-specific)
*pvDataIn_*	Pointer to the intput data
*usSizeIn_*	Size of the input data (in bytes)
*pvDataOut_*	Pointer to the output data
*usSizeOut_*	Size of the output data (in bytes)

Returns

Driver-specific return code, 0 = OK, non-0 = error

Implements Driver.

Definition at line 53 of file driver.cpp.

13.10.2.3 virtual K_UCHAR DevNull::Open ( ) [inline], [virtual]

Open a device driver prior to use.

Returns

Driver-specific return code, 0 = OK, non-0 = error

Implements Driver.

Definition at line 44 of file driver.cpp.

13.10.2.4 virtual K_USHORT DevNull::Read (K_USHORT *usBytes_*, K_UCHAR * *pucData_*) [inline], [virtual]

Read a specified number of bytes from the device into a specific buffer.

Depending on the driver-specific implementation, this may be a number less than the requested number of bytes read, indicating that there there was less input than desired, or that as a result of buffering, the data may not be available.

Parameters

*usBytes_*	Number of bytes to read (<= size of the buffer)
*pucData_*	Pointer to a data buffer receiving the read data

Returns

Number of bytes actually read

Implements Driver.

Definition at line 47 of file driver.cpp.

13.10.2.5 virtual K_USHORT DevNull::Write (K_USHORT *usBytes_*, K_UCHAR * *pucData_*) [inline], [virtual]

Write a payload of data of a given length to the device.

Depending on the implementation of the driver, the amount of data written to the device may be less than the requested number of bytes. A result less than the requested size may indicate that the device buffer is full, indicating that the user must retry the write at a later point with the remaining data.

Parameters

*usBytes_*	Number of bytes to write (<= size of the buffer)
*pucData_*	Pointer to a data buffer containing the data to write

Returns

Number of bytes actually written

Implements Driver.

Definition at line 50 of file driver.cpp.

The documentation for this class was generated from the following file:

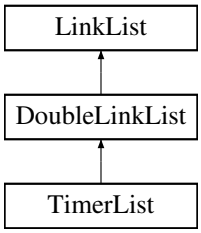
- /home/moslevin2/mark3/embedded/stage/src/driver.cpp

13.11 DoubleLinkList Class Reference

Doubly-linked-list data type, inherited from the base LinkList type.

`#include <ll.h>`

Inheritance diagram for DoubleLinkList:



Public Member Functions

- DoubleLinkList ()

  Default constructor - initializes the head/tail nodes to NULL.
- virtual void Add (LinkListNode *node_)

  Add the linked list node to this linked list.
- virtual void Remove (LinkListNode *node_)

  Add the linked list node to this linked list.

Additional Inherited Members

13.11.1 Detailed Description

Doubly-linked-list data type, inherited from the base LinkList type.

Definition at line 170 of file ll.h.

13.11.2 Member Function Documentation

13.11.2.1 void DoubleLinkList::Add (LinkListNode * *node_*) [virtual]

Add the linked list node to this linked list.

Parameters

*node_*	Pointer to the node to add

Implements LinkList.

Definition at line 40 of file ll.cpp.

13.11.2.2 void DoubleLinkList::Remove (LinkListNode * *node_*) [virtual]

Add the linked list node to this linked list.

Parameters

*node_*	Pointer to the node to remove

Implements LinkList.

Definition at line 64 of file ll.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/ll.h
- /home/moslevin2/mark3/embedded/stage/src/ll.cpp

13.12 DrawBitmap_t Struct Reference

Defines a bitmap.

`#include <draw.h>`

Public Attributes

- K_USHORT usX

  Leftmost pixel.
- K_USHORT usY

  Uppermost pixel.
- K_USHORT usWidth

  Width of the bitmap in pixels.
- K_USHORT usHeight

  Height of the bitmap in pixels.
- K_UCHAR ucBPP

  Bits-per-pixel.
- K_UCHAR * pucData

  Pixel data pointer.

13.12.1 Detailed Description

Defines a bitmap.

Definition at line 117 of file draw.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/draw.h

13.13 DrawCircle_t Struct Reference

Defines a circle.

`#include <draw.h>`

Public Attributes

- K_USHORT usX
  Center X pixel.
- K_USHORT usY
  Center Y pixel.
- K_USHORT usRadius
  Radius in pixels.
- COLOR uLineColor
  Color of the circle perimeter.
- K_BOOL bFill
  Whether or not to fill the interior of the circle.
- COLOR uFillColor
  Fill color for the circle.

13.13.1 Detailed Description

Defines a circle.

Definition at line 92 of file draw.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/draw.h

13.14 DrawEllipse_t Struct Reference

Defines a ellipse.

`#include <draw.h>`

Public Attributes

- K_USHORT usX
  Center X pixel.
- K_USHORT usY
  Center Y pixel.
- K_USHORT usHeight
  Height of the ellipse.
- K_USHORT usWidth
  Width of the ellipse.
- COLOR uColor
  Color of the ellipse perimeter.

13.14.1 Detailed Description

Defines a ellipse.

Definition at line 105 of file draw.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/draw.h

13.15 DrawLine_t Struct Reference

Defines a simple line.

`#include <draw.h>`

Public Attributes

- K_USHORT usX1

  Starting X coordinate.
- K_USHORT usX2

  Ending X coordinate.
- K_USHORT usY1

  Starting Y Coordinate.
- K_USHORT usY2

  Ending Y coordinate.
- COLOR uColor

  Color of the pixel.

13.15.1 Detailed Description

Defines a simple line.

Definition at line 66 of file draw.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/draw.h

13.16 DrawMove_t Struct Reference

Simple 2D copy/paste.

`#include <draw.h>`

Public Attributes

- K_USHORT usSrcX

  Source X pixel (leftmost)
- K_USHORT usSrcY

  Source Y pixel (topmost)
- K_USHORT usDstX

  Destination X pixel (leftmost)
- K_USHORT usDstY

  Destination Y pixel (topmost)
- K_USHORT usCopyHeight

  Number of rows to copy.
- K_USHORT usCopyWidth

  Number of columns to copy.

13.16.1 Detailed Description

Simple 2D copy/paste.

Moves a bitmap specified by the given source coordinates on-surface to the destination coordinates.

Definition at line 172 of file draw.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/draw.h

13.17 DrawPoint_t Struct Reference

Defines a pixel.

`#include <draw.h>`

Public Attributes

- K_USHORT usX

  X coordinate of the pixel.
- K_USHORT usY

  Y coordinate of the pixel.
- COLOR uColor

  Color of the pixel.

13.17.1 Detailed Description

Defines a pixel.

Definition at line 55 of file draw.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/draw.h

13.18 DrawPoly_t Struct Reference

Defines the structure of an arbitrary polygon.

`#include <draw.h>`

Public Attributes

- K_USHORT usNumPoints

  Number of points in the polygon.
- COLOR uColor

  Color to use for lines/fill.
- K_BOOL bFill

  Display as wireframe or filled.
- DrawVector_t * pstVector

  Vector points making the polygon.

13.18.1 Detailed Description

Defines the structure of an arbitrary polygon.

Can be used to specify the

Definition at line 199 of file draw.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/draw.h

13.19 DrawRectangle_t Struct Reference

Defines a rectangle.

`#include <draw.h>`

Public Attributes

- K_USHORT usLeft

  Leftmost pixel of the rectangle.
- K_USHORT usTop

  Topmost pixel of the rectangle.
- K_USHORT usRight

  Rightmost pixel of the rectangle.
- K_USHORT usBottom

  Bottom pixel of the rectangle.
- COLOR uLineColor

  Color of the line.
- K_BOOL bFill

  Whether or not to floodfill the interior.
- COLOR uFillColor

  Color of the interior of the rectangle.

13.19.1 Detailed Description

Defines a rectangle.

Definition at line 78 of file draw.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/draw.h

13.20 DrawStamp_t Struct Reference

Defines a 1-bit 2D bitmap of arbitrary resolution.

`#include <draw.h>`

Public Attributes

- K_USHORT usX
  Leftmost pixel.
- K_USHORT usY
  Uppermost pixel.
- K_USHORT usWidth
  Width of the stamp.
- K_USHORT usHeight
  Height of the stamp.
- COLOR uColor
  Color of the stamp.
- K_UCHAR * pucData
  Pointer to the stamp data.

13.20.1 Detailed Description

Defines a 1-bit 2D bitmap of arbitrary resolution.

Definition at line 130 of file draw.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/draw.h

13.21 DrawText_t Struct Reference

Defines a bitmap-rendered string.

`#include <draw.h>`

Public Attributes

- K_USHORT usLeft
  Leftmost pixel of the text.
- K_USHORT usTop
  Uppermost pixel of the text.
- COLOR uColor
  Color of the text.
- Font_t * pstFont
  Pointer to the font used to render the text.
- const K_CHAR * pcString
  ASCII String to render.

13.21.1 Detailed Description

Defines a bitmap-rendered string.

Definition at line 144 of file draw.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/draw.h

13.22 DrawVector_t Struct Reference

Specifies a single 2D point.

`#include <draw.h>`

Public Attributes

- K_USHORT **usX**
- K_USHORT **usY**

13.22.1 Detailed Description

Specifies a single 2D point.

When used in arrays, this provides a way to draw vector paths, which form the basis of the polygon data structures.

Definition at line 188 of file draw.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/draw.h

13.23 DrawWindow_t Struct Reference

Defines the active window - establishes boundaries for drawing on the current display.

`#include <draw.h>`

Public Attributes

- K_USHORT usLeft

  Left boundary.
- K_USHORT usRight

  Right boundary.
- K_USHORT usTop

  Upper boundary.
- K_USHORT usBottom

  Bottom boundary.

13.23.1 Detailed Description

Defines the active window - establishes boundaries for drawing on the current display.

Only pixels drawn inside the surface boundaries are rendered to the output

Definition at line 159 of file draw.h.

The documentation for this struct was generated from the following file:

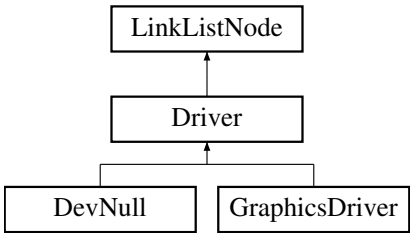
- /home/moslevin2/mark3/embedded/stage/src/draw.h

13.24 Driver Class Reference

Base device-driver class used in hardware abstraction.

`#include <driver.h>`

Inheritance diagram for Driver:



Public Member Functions

- virtual void Init ()=0

  Initialize a driver, must be called prior to use.
- virtual K_UCHAR Open ()=0

  Open a device driver prior to use.
- virtual K_UCHAR Close ()=0

  Close a previously-opened device driver.
- virtual K_USHORT Read (K_USHORT usBytes_, K_UCHAR *pucData_)=0

  Read a specified number of bytes from the device into a specific buffer.
- virtual K_USHORT Write (K_USHORT usBytes_, K_UCHAR *pucData_)=0

  Write a payload of data of a given length to the device.
- virtual K_USHORT Control (K_USHORT usEvent_, void *pvDataIn_, K_USHORT usSizeIn_, void *pvDataOut_, K_USHORT usSizeOut_)=0

  This is the main entry-point for device-specific io and control operations.
- void SetName (const K_CHAR *pcName_)

  Set the path for the driver.
- const K_CHAR * GetPath ()

  Returns a string containing the device path.

Private Attributes

- const K_CHAR * m_pcPath

  string pointer that holds the driver path (name)

Additional Inherited Members

13.24.1 Detailed Description

Base device-driver class used in hardware abstraction.

All other device drivers inherit from this class

Definition at line 121 of file driver.h.

13.24.2 Member Function Documentation

13.24.2.1 K_UCHAR Driver::Close ( ) [pure virtual]

Close a previously-opened device driver.

Returns

Driver-specific return code, 0 = OK, non-0 = error

Implemented in DevNull.

13.24.2.2 K_USHORT Driver::Control (K_USHORT *usEvent_*, void * *pvDataIn_*, K_USHORT *usSizeIn_*, void * *pvDataOut_*, K_USHORT *usSizeOut_*) [pure virtual]

This is the main entry-point for device-specific io and control operations.

This is used for implementing all "side-channel" communications with a device, and any device-specific IO operations that do not conform to the typical POSIX read/write paradigm. Use of this funciton is analagous to the non-POSIX (yet still common) devctl() or ioctl().

Parameters

*usEvent_*	Code defining the io event (driver-specific)
*pvDataIn_*	Pointer to the intput data
*usSizeIn_*	Size of the input data (in bytes)
*pvDataOut_*	Pointer to the output data
*usSizeOut_*	Size of the output data (in bytes)

Returns

Driver-specific return code, 0 = OK, non-0 = error

Implemented in DevNull.

13.24.2.3 const K_CHAR * Driver::GetPath ( ) [inline]

Returns a string containing the device path.

Returns

pcName_ Return the string constant representing the device path

Definition at line 231 of file driver.h.

13.24.2.4 K_UCHAR Driver::Open ( ) [pure virtual]

Open a device driver prior to use.

Returns

Driver-specific return code, 0 = OK, non-0 = error

Implemented in DevNull.

13.24.2.5 K_USHORT Driver::Read (K_USHORT *usBytes_*, K_UCHAR * *pucData_*) [pure virtual]

Read a specified number of bytes from the device into a specific buffer.

Depending on the driver-specific implementation, this may be a number less than the requested number of bytes read, indicating that there there was less input than desired, or that as a result of buffering, the data may not be available.

Parameters

*usBytes_*	Number of bytes to read (<= size of the buffer)
*pucData_*	Pointer to a data buffer receiving the read data

Returns

Number of bytes actually read

Implemented in DevNull.

13.24.2.6 void Driver::SetName (const K_CHAR * *pcName_*) [inline]

Set the path for the driver.

Name must be set prior to access (since driver access is name-based).

Parameters

*pcName_*	String constant containing the device path

Definition at line 222 of file driver.h.

13.24.2.7 K_USHORT Driver::Write (K_USHORT *usBytes_*, K_UCHAR * *pucData_*) [pure virtual]

Write a payload of data of a given length to the device.

Depending on the implementation of the driver, the amount of data written to the device may be less than the requested number of bytes. A result less than the requested size may indicate that the device buffer is full, indicating that the user must retry the write at a later point with the remaining data.

Parameters

*usBytes_*	Number of bytes to write (<= size of the buffer)
*pucData_*	Pointer to a data buffer containing the data to write

Returns

Number of bytes actually written

Implemented in DevNull.

The documentation for this class was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/driver.h

13.25 DriverList Class Reference

List of Driver objects used to keep track of all device drivers in the system.

`#include <driver.h>`

Static Public Member Functions

- static void Init ()

  Initialize the list of drivers.
- static void Add (Driver *pclDriver_)

  Add a Driver object to the managed global driver-list.
- static void Remove (Driver *pclDriver_)

  Remove a driver from the global driver list.
- static Driver * FindByPath (const K_CHAR *m_pcPath)

  Look-up a driver in the global driver-list based on its path.

Static Private Attributes

- static DoubleLinkList m_clDriverList

  LinkedList object used to implementing the driver object management.

13.25.1 Detailed Description

List of Driver objects used to keep track of all device drivers in the system.

By default, the list contains a single entity, "/dev/null".

Definition at line 244 of file driver.h.

13.25.2 Member Function Documentation

13.25.2.1 DriverList::Add (Driver * *pclDriver_*) [inline], [static]

Add a Driver object to the managed global driver-list.

Parameters

*pclDriver_*	pointer to the driver object to add to the global driver list.

Definition at line 264 of file driver.h.

13.25.2.2 Driver * DriverList::FindByPath (const K_CHAR * *m_pcPath*) [static]

Look-up a driver in the global driver-list based on its path.

In the event that the driver is not found in the list, a pointer to the default "/dev/null" object is returned. In this way, unimplemented drivers are automatically stubbed out.

Definition at line 97 of file driver.cpp.

13.25.2.3 void DriverList::Init ( ) [static]

Initialize the list of drivers.

Must be called prior to using the device driver library.

Definition at line 88 of file driver.cpp.

13.25.2.4 void DriverList::Remove (Driver * *pclDriver_*) [inline], [static]

Remove a driver from the global driver list.

Parameters

*pclDriver_*	Pointer to the driver object to remove from the global table

Definition at line 274 of file driver.h.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/driver.h
- /home/moslevin2/mark3/embedded/stage/src/driver.cpp

13.26 FixedHeap Class Reference

Fixed-size-block heap allocator with multiple block sizes.

`#include <fixed_heap.h>`

Public Member Functions

- void Create (void *pvHeap_, HeapConfig *pclHeapConfig_)

  Creates a heap in a provided blob of memory with lists of fixed-size blocks configured based on the associated configuration data.
- void * Alloc (K_USHORT usSize_)

  Allocate a blob of memory from the heap.

Static Public Member Functions

- static void Free (void *pvNode_)

  Free a previously-allocated block of memory to the heap it was originally allocated from.

Private Attributes

- HeapConfig * m_paclHeaps

  Pointer to the configuration data used by the heap.

13.26.1 Detailed Description

Fixed-size-block heap allocator with multiple block sizes.

Definition at line 104 of file fixed_heap.h.

13.26.2 Member Function Documentation

13.26.2.1 void * FixedHeap::Alloc (K_USHORT *usSize_*)

Allocate a blob of memory from the heap.

If no appropriately-sized data block is available, will return NULL. Note, this API is thread- safe, and interrupt safe.

Parameters

*usSize_*	Size (in bytes) to allocate from the heap

Returns

Pointer to a block of data allocated, or 0 on error.

Definition at line 130 of file fixed_heap.cpp.

13.26.2.2 void FixedHeap::Create (void * *pvHeap_*, HeapConfig * *pclHeapConfig_*)

Creates a heap in a provided blob of memory with lists of fixed-size blocks configured based on the associated configuration data.

A heap must be created before it can be allocated/freed.

Parameters

*pvHeap_*	Pointer to the data blob that will contain the heap
*pclHeapConfig_*	Pointer to the array of config objects that define how the heap is laid out in memory, and how many blocks of what size are included. The objects in the array must be initialized, starting from smallest block-size to largest, with the final entry in the table have a 0-block size, indicating end-of-configuration.

Definition at line 113 of file fixed_heap.cpp.

13.26.2.3 void FixedHeap::Free (void * *pvNode_*) [static]

Free a previously-allocated block of memory to the heap it was originally allocated from.

This must point to the block of memory at its originally-returned pointer, and not an address within an allocated blob (as supported by some allocators).

Parameters

*pvNode_*	Pointer to the previously-allocated block of memory

Definition at line 160 of file fixed_heap.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/fixed_heap.h
- /home/moslevin2/mark3/embedded/stage/src/fixed_heap.cpp

13.27 Font_t Struct Reference

Public Attributes

- K_UCHAR **ucSize**
- K_UCHAR **ucFlags**
- K_UCHAR **ucStartChar**
- K_UCHAR **ucMaxChar**
- const K_CHAR * **szName**
- const FONT_STORAGE_TYPE * **pucFontData**

13.27.1 Detailed Description

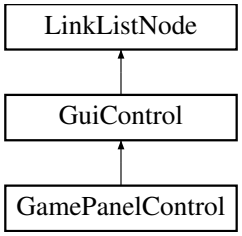
Definition at line 43 of file font.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/font.h

13.28 GamePanelControl Class Reference

Inheritance diagram for GamePanelControl:



Public Member Functions

- virtual void Init ()

  Initiailize the control - must be called before use.
- virtual void Draw ()

  Redraw the control "cleanly".
- virtual GuiReturn_t ProcessEvent (GuiEvent_t *pstEvent_)

  Process an event sent to the control.
- virtual void Activate (bool bActivate_)

  Activate or deactivate the current control - used when switching from one active control to another.

Private Attributes

- JoystickEvent_t **m_stLastJoy**
- JoystickEvent_t **m_stCurrentJoy**

Additional Inherited Members

13.28.1 Detailed Description

Definition at line 32 of file control_gamepanel.h.

13.28.2 Member Function Documentation

13.28.2.1 virtual void GamePanelControl::Activate (bool *bActivate_*) [inline], [virtual]

Activate or deactivate the current control - used when switching from one active control to another.

Parameters

*bActivate_*	- true to activate, false to deactivate

Implements GuiControl.

Definition at line 38 of file control_gamepanel.h.

13.28.2.2 void GamePanelControl::Draw ( ) [virtual]

Redraw the control "cleanly".

Subclass specific.

Implements GuiControl.

Definition at line 27 of file control_gamepanel.cpp.

13.28.2.3 virtual void GamePanelControl::Init ( ) [inline], [virtual]

Initiailize the control - must be called before use.

Implementation is subclass specific.

Implements GuiControl.

Definition at line 35 of file control_gamepanel.h.

13.28.2.4 GuiReturn_t GamePanelControl::ProcessEvent (GuiEvent_t * *pstEvent_*) [virtual]

Process an event sent to the control.

Subclass specific implementation.

Parameters

*pstEvent_*	Pointer to a struct containing the event data

Implements GuiControl.

Definition at line 33 of file control_gamepanel.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/control_gamepanel.h
- /home/moslevin2/mark3/embedded/stage/src/control_gamepanel.cpp

13.29 GlobalMessagePool Class Reference

Implements a list of message objects shared between all threads.

`#include <message.h>`

Static Public Member Functions

- static void Init ()

  Initialize the message queue prior to use.
- static void Push (Message *pclMessage_)

  Return a previously-claimed message object back to the global queue.
- static Message * Pop ()

  Pop a message from the global queue, returning it to the user to be populated before sending by a transmitter.

Static Private Attributes

- static Message m_aclMessagePool [GLOBAL_MESSAGE_POOL_SIZE]

  Array of message objects that make up the message pool.
- static DoubleLinkList m_clList

  Linked list used to manage the Message objects.

13.29.1 Detailed Description

Implements a list of message objects shared between all threads.

Definition at line 157 of file message.h.

13.29.2 Member Function Documentation

13.29.2.1 Message * GlobalMessagePool::Pop ( ) [static]

Pop a message from the global queue, returning it to the user to be populated before sending by a transmitter.

Returns

Pointer to a Message object

Definition at line 69 of file message.cpp.

13.29.2.2 void GlobalMessagePool::Push (Message * *pclMessage_*) [static]

Return a previously-claimed message object back to the global queue.

Used once the message has been processed by a receiver.

Parameters

*pclMessage_*	Pointer to the Message object to return back to the global queue

Definition at line 57 of file message.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/message.h
- /home/moslevin2/mark3/embedded/stage/src/message.cpp

13.30 Glyph_t Struct Reference

Public Attributes

- K_UCHAR ucWidth

  Width of this font glyph in pixels.
- K_UCHAR ucHeight

  Height of this font glyph in pixels.
- K_UCHAR ucVOffset

  Vertical offset of this glyph.
- K_UCHAR aucData [1]

  Glyph data array.

13.30.1 Detailed Description

Definition at line 26 of file font.h.

The documentation for this struct was generated from the following file:

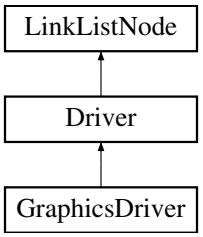
- /home/moslevin2/mark3/embedded/stage/src/font.h

13.31 GraphicsDriver Class Reference

Defines the base graphics driver class, which is inherited by all other graphics drivers.

`#include <graphics.h>`

Inheritance diagram for GraphicsDriver:



Public Member Functions

- virtual void DrawPixel (DrawPoint_t *pstPoint_)
  Draw a single pixel to the display.
- virtual void ReadPixel (DrawPoint_t *pstPoint_)
  Read a single pixel from the display.
- virtual void ClearScreen ()
  Clear the screen (initializes to all black pixels)
- virtual void Point (DrawPoint_t *pstPoint_)
  Draw a pixel to the display.
- virtual void Line (DrawLine_t *pstLine_)
  Draw a line to the display using Bresenham's line drawing algorithm.
- virtual void Rectangle (DrawRectangle_t *pstRectangle_)
  Draws a rectangle on the display.
- virtual void Circle (DrawCircle_t *pstCircle_)
  Draw a circle to the display.
- virtual void Ellipse (DrawEllipse_t *pstEllipse_)
  Draw an ellipse to the display.
- virtual void Bitmap (DrawBitmap_t *pstBitmap_)
  Draw an RGB image on the display.
- virtual void Stamp (DrawStamp_t *pstStamp_)
  Draws a stamp (a 1-bit bitmap) on the display.
- virtual void Move (DrawMove_t *pstMove_)
  Move a the contents from one rectangle on screen to another rectangle, specified by the values of the input structure.
- virtual void TriangleWire (DrawPoly_t *pstPoly_)
  Draw a wireframe triangle to the display.
- virtual void TriangleFill (DrawPoly_t *pstPoly_)
  Draw a filled triangle to the display.

- virtual void **Polygon** (DrawPoly_t *pstPoly_)
- virtual void Text (DrawText_t *pstText_)

  Draw a string of text to the display using a bitmap font.
- virtual K_USHORT **TextWidth** (DrawText_t *pstText_)
- void SetWindow (DrawWindow_t *pstWindow_)

  Set the drawable window of the screen.
- void ClearWindow ()

  Clear the window - resetting the boundaries to the entire drawable area of the screen.

Protected Attributes

- K_USHORT **m_usResX**
- K_USHORT **m_usResY**
- K_USHORT **m_usLeft**
- K_USHORT **m_usTop**
- K_USHORT **m_usRight**
- K_USHORT **m_usBottom**
- K_UCHAR **m_ucBPP**

Additional Inherited Members

13.31.1 Detailed Description

Defines the base graphics driver class, which is inherited by all other graphics drivers.

Per-pixel rendering functions for all raster operations is provided by default. These can be overridden with more efficient hardware-supported operations where available.

Definition at line 32 of file graphics.h.

13.31.2 Member Function Documentation

13.31.2.1 void GraphicsDriver::Bitmap (DrawBitmap_t * *pstBitmap_*) [virtual]

Draw an RGB image on the display.

Parameters

*pstBitmap_*	- pointer to the bitmap object to display

Definition at line 300 of file graphics.cpp.

13.31.2.2 void GraphicsDriver::Circle (DrawCircle_t * *pstCircle_*) [virtual]

Draw a circle to the display.

Parameters

*pstCircle_*	- pointer to the circle to draw

Definition at line 176 of file graphics.cpp.

13.31.2.3 void GraphicsDriver::DrawPixel (DrawPoint_t * pstPoint_) [inline], [virtual]

Draw a single pixel to the display.

Parameters

*pstPoint_*	Structure containing the pixel data (color/location) to be written.

Definition at line 49 of file graphics.h.

13.31.2.4 void GraphicsDriver::Ellipse (DrawEllipse_t * pstEllipse_) [virtual]

Draw an ellipse to the display.

Parameters

*pstEllipse_*	- pointer to the ellipse to draw on the display

Definition at line 248 of file graphics.cpp.

13.31.2.5 void GraphicsDriver::Line (DrawLine_t * pstLine_) [virtual]

Draw a line to the display using Bresenham's line drawing algorithm.

Parameters

*pstLine_*	- pointer to the line structure

Definition at line 48 of file graphics.cpp.

13.31.2.6 void GraphicsDriver::Move (DrawMove_t * pstMove_) [virtual]

Move a the contents from one rectangle on screen to another rectangle, specified by the values of the input structure.

Parameters

*pstMove_*	- object describing the graphics movement operation (framebuffer operations only).

Definition at line 438 of file graphics.cpp.

13.31.2.7 void GraphicsDriver::Point (DrawPoint_t * pstPoint_) [virtual]

Draw a pixel to the display.

Parameters

*pstPoint_*	- pointer to the struct containing the pixel to draw

Definition at line 42 of file graphics.cpp.

13.31.2.8 void GraphicsDriver::ReadPixel (DrawPoint_t * pstPoint_) [inline], [virtual]

Read a single pixel from the display.

Parameters

*pstPoint_*	Structure containing the pixel location of the pixel to be read. The color value will contain the value from the display when read.

Definition at line 58 of file graphics.h.

13.31.2.9 void GraphicsDriver::Rectangle (DrawRectangle_t * *pstRectangle_*) [virtual]

Draws a rectangle on the display.

Parameters

*pstRectangle_*	- pointer to the rectangle struct

Definition at line 131 of file graphics.cpp.

13.31.2.10 void GraphicsDriver::SetWindow (DrawWindow_t * *pstWindow_*)

Set the drawable window of the screen.

Parameters

*pstWindow_*	- pointer to the window struct defining the drawable area

Definition at line 882 of file graphics.cpp.

13.31.2.11 void GraphicsDriver::Stamp (DrawStamp_t * *pstStamp_*) [virtual]

Draws a stamp (a 1-bit bitmap) on the display.

Parameters

*pstStamp_*	- pointer to the stamp object to draw

Definition at line 399 of file graphics.cpp.

13.31.2.12 void GraphicsDriver::Text (DrawText_t * *pstText_*) [virtual]

Draw a string of text to the display using a bitmap font.

Parameters

*pstText_*	- pointer to the text object to render

Definition at line 499 of file graphics.cpp.

13.31.2.13 void GraphicsDriver::TriangleFill (DrawPoly_t * *pstPoly_*) [virtual]

Draw a filled triangle to the display.

Parameters

*pstPoly_*	Pointer to the polygon to draw.

Definition at line 655 of file graphics.cpp.

13.31.2.14 void GraphicsDriver::TriangleWire (DrawPoly_t * *pstPoly_*) [virtual]

Draw a wireframe triangle to the display.

Parameters

*pstPoly_*	Pointer to the polygon to draw.

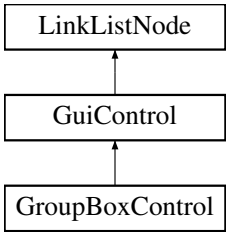
Definition at line 630 of file graphics.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/graphics.h
- /home/moslevin2/mark3/embedded/stage/src/graphics.cpp

13.32 GroupBoxControl Class Reference

Inheritance diagram for GroupBoxControl:



Public Member Functions

- virtual void Init ()

  Initiailize the control - must be called before use.
- virtual void Draw ()

  Redraw the control "cleanly".
- virtual GuiReturn_t ProcessEvent (GuiEvent_t *pstEvent_)

  Process an event sent to the control.
- virtual void Activate (bool bActivate_)

  Activate or deactivate the current control - used when switching from one active control to another.
- void **SetPanelColor** (COLOR eColor_)
- void **SetLineColor** (COLOR eColor_)
- void **SetFontColor** (COLOR eColor_)
- void **SetFont** (Font_t *pstFont_)
- void **SetCaption** (const K_CHAR *pcCaption_)

Private Attributes

- COLOR **m_uPanelColor**
- COLOR **m_uLineColor**
- COLOR **m_uFontColor**
- Font_t * **m_pstFont**
- const K_CHAR * **m_pcCaption**

Additional Inherited Members

13.32.1 Detailed Description

Definition at line 29 of file control_groupbox.h.

13.32.2 Member Function Documentation

13.32.2.1 virtual void GroupBoxControl::Activate (bool *bActivate_*) [inline], [virtual]

Activate or deactivate the current control - used when switching from one active control to another.

Parameters

*bActivate_*	- true to activate, false to deactivate

Implements GuiControl.

Definition at line 38 of file control_groupbox.h.

13.32.2.2 void GroupBoxControl::Draw ( ) [virtual]

Redraw the control "cleanly".

Subclass specific.

Implements GuiControl.

Definition at line 30 of file control_groupbox.cpp.

13.32.2.3 virtual void GroupBoxControl::Init ( ) [inline], [virtual]

Initiailize the control - must be called before use.

Implementation is subclass specific.

Implements GuiControl.

Definition at line 32 of file control_groupbox.h.

13.32.2.4 virtual GuiReturn_t GroupBoxControl::ProcessEvent (GuiEvent_t * *pstEvent_*) [inline], [virtual]

Process an event sent to the control.

Subclass specific implementation.

Parameters

*pstEvent_*	Pointer to a struct containing the event data

Implements GuiControl.

Definition at line 37 of file control_groupbox.h.

The documentation for this class was generated from the following files:

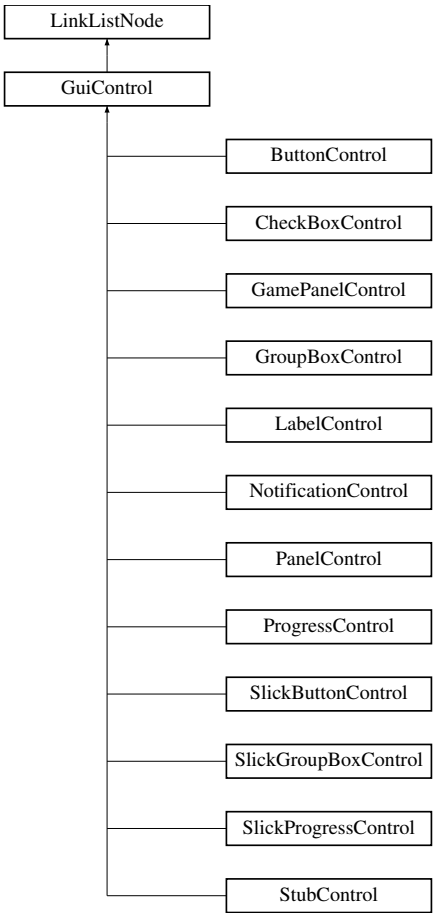
- /home/moslevin2/mark3/embedded/stage/src/control_groupbox.h
- /home/moslevin2/mark3/embedded/stage/src/control_groupbox.cpp

13.33 GuiControl Class Reference

GUI Control Base Class.

`#include <gui.h>`

Inheritance diagram for GuiControl:



Public Member Functions

- virtual void Init ()=0

  Initiailize the control - must be called before use.
- virtual void Draw ()=0

  Redraw the control "cleanly".
- virtual GuiReturn_t ProcessEvent (GuiEvent_t *pstEvent_)=0

  Process an event sent to the control.
- void SetTop (K_USHORT usTop_)

  Set the location of the topmost pixel of the control.
- void SetLeft (K_USHORT usLeft_)

  Set the location of the leftmost pixel of the control.
- void SetHeight (K_USHORT usHeight_)

  Set the height of the control (in pixels)
- void SetWidth (K_USHORT usWidth_)

  Set the width of the control (in pixels)
- void SetZOrder (K_UCHAR ucZ_)

Set the Z-order (depth) of the control.

- void SetControlIndex (K_UCHAR ucIdx_)

  Set the index of the control, used for cycling through focus (ala tab order in VB).
- K_USHORT GetTop ()

  Return the topmost pixel of the control.
- K_USHORT GetLeft ()

  Return the leftmost pixel of the control.
- K_USHORT GetHeight ()

  Get the height of the control in pixels.
- K_USHORT GetWidth ()

  Get the width of the control in pixels.
- K_UCHAR GetZOrder ()

  Return the Z-order of the control.
- K_UCHAR GetControlIndex ()

  Return the Control Index of the control.
- K_BOOL IsStale ()

  Return whether or not the control needs to be redrawn or not.
- void GetControlOffset (K_USHORT *pusX_, K_USHORT *pusY_)

  Return the absolute offset of the control within an event surface.
- K_BOOL IsInFocus ()

  Return whether or not the current control has the focus in the window.
- virtual void Activate (bool bActivate_)=0

  Activate or deactivate the current control - used when switching from one active control to another.

Protected Member Functions

- void SetParentControl (GuiControl *pclParent_)

  Set the parent control of this control.
- void SetParentWindow (GuiWindow *pclWindow_)

  Set the parent window of this control.
- GuiControl * GetParentControl ()

  Return the pointer to the control's currently-assigned parent control.
- GuiWindow * GetParentWindow ()

  Get the parent window of this control.
- void ClearStale ()

  Clear the stale flag for this control.
- void SetStale ()

  Signal that the object needs to be redrawn.
- void SetAcceptFocus (bool bFocus_)

  Tell the control whether or not to accept focus.
- bool AcceptsFocus ()

  Returns whether or not this control accepts focus.

Private Attributes

- K_BOOL m_bStale

  true if the control is stale and needs to be redrawn, false otherwise
- K_BOOL m_bAcceptsFocus

  Whether or not the control accepts focus or not.
- K_UCHAR m_ucZOrder

The Z-Order (depth) of the control.

- K_UCHAR m_ucControlIndex

  Index of the control in the window.
- K_USHORT m_usTop

  Topmost location of the control on the window.
- K_USHORT m_usLeft

  Leftmost location of the control on the window.
- K_USHORT m_usWidth

  Width of the control in pixels.
- K_USHORT m_usHeight

  Height of the control in pixels.
- GuiControl * m_pclParentControl

  Pointer to the parent control.
- GuiWindow * m_pclParentWindow

  Pointer to the parent window associated with this control.

Friends

- class **GuiWindow**
- class **GuiEventSurface**

Additional Inherited Members

13.33.1 Detailed Description

GUI Control Base Class.

This class is the common ancestor to all GUI control elements. It defines a base set of properties common to all controls, as well as methods for initialization, event handling, and redrawing. Controls are directly related to Windows, which are used to manage and organize controls.

Definition at line 538 of file gui.h.

13.33.2 Member Function Documentation

13.33.2.1 void GuiControl::Activate (bool *bActivate_*) [pure virtual]

Activate or deactivate the current control - used when switching from one active control to another.

Parameters

*bActivate_*	- true to activate, false to deactivate

Implemented in StubControl, NotificationControl, LabelControl, ButtonControl, PanelControl, SlickButtonControl, GamePanelControl, GroupBoxControl, ProgressControl, SlickProgressControl, CheckBoxControl, and SlickGroupBoxControl.

13.33.2.2 void GuiControl::ClearStale ( ) [inline], [protected]

Clear the stale flag for this control.

Should only be done after a redraw has been completed

Definition at line 741 of file gui.h.

13.33.2.3 void GuiControl::Draw ( ) [pure virtual]

Redraw the control "cleanly".

Subclass specific.

Implemented in StubControl, NotificationControl, LabelControl, ButtonControl, PanelControl, SlickButtonControl, GamePanelControl, GroupBoxControl, ProgressControl, SlickProgressControl, CheckBoxControl, and SlickGroupBoxControl.

13.33.2.4 K_UCHAR GuiControl::GetControlIndex ( ) [inline]

Return the Control Index of the control.

Returns

The control index of the control

Definition at line 648 of file gui.h.

13.33.2.5 void GuiControl::GetControlOffset (K_USHORT * *pusX_*, K_USHORT * *pusY_*)

Return the absolute offset of the control within an event surface.

This function will traverse through all of the object's parents, and their parents, until the root control and root window are identified. The absolute pixel locations of the Topmost (Y) and Leftmost (X) pixels are populated in the

Parameters

*pusX_*	Pointer to the K_USHORT containing the leftmost pixel
*pusY_*	Pointer to the K_USHORT containing the topmost pixel

Definition at line 669 of file gui.cpp.

13.33.2.6 K_USHORT GuiControl::GetHeight ( ) [inline]

Get the height of the control in pixels.

Returns

Height of the control in pixels

Definition at line 627 of file gui.h.

13.33.2.7 K_USHORT GuiControl::GetLeft ( ) [inline]

Return the leftmost pixel of the control.

Returns

Leftmost pixel of the control

Definition at line 620 of file gui.h.

13.33.2.8 GuiControl * GuiControl::GetParentControl ( ) [inline], [protected]

Return the pointer to the control's currently-assigned parent control.

Returns

Pointer to the Control's currently assigned parent control.

Definition at line 725 of file gui.h.

13.33.2.9 GuiWindow * GuiControl::GetParentWindow ( ) [inline], [protected]

Get the parent window of this control.

Returns

Pointer to the control's window

Definition at line 733 of file gui.h.

13.33.2.10 K_USHORT GuiControl::GetTop ( ) [inline]

Return the topmost pixel of the control.

Returns

Topmost pixel of the control

Definition at line 613 of file gui.h.

13.33.2.11 K_USHORT GuiControl::GetWidth ( ) [inline]

Get the width of the control in pixels.

Returns

Width of the control in pixels

Definition at line 634 of file gui.h.

13.33.2.12 K_UCHAR GuiControl::GetZOrder ( ) [inline]

Return the Z-order of the control.

Returns

Z-order of the control

Definition at line 641 of file gui.h.

13.33.2.13 void GuiControl::Init ( ) [pure virtual]

Initiailize the control - must be called before use.

Implementation is subclass specific.

Implemented in StubControl, ButtonControl, PanelControl, SlickButtonControl, GamePanelControl, LabelControl, NotificationControl, ProgressControl, SlickProgressControl, CheckBoxControl, GroupBoxControl, and SlickGroupBoxControl.

13.33.2.14 K_BOOL GuiControl::IsInFocus ( ) [inline]

Return whether or not the current control has the focus in the window.

Returns

true if this control is in focus, false otherwise

Definition at line 677 of file gui.h.

13.33.2.15 K_BOOL GuiControl::IsStale ( ) [inline]

Return whether or not the control needs to be redrawn or not.

Returns

true - control needs redrawing, false - control is intact.

Definition at line 655 of file gui.h.

13.33.2.16 GuiReturn_t GuiControl::ProcessEvent (GuiEvent_t * *pstEvent_*) [pure virtual]

Process an event sent to the control.

Subclass specific implementation.

Parameters

*pstEvent_*	Pointer to a struct containing the event data

Implemented in StubControl, NotificationControl, LabelControl, ButtonControl, PanelControl, SlickButtonControl, GamePanelControl, GroupBoxControl, ProgressControl, SlickProgressControl, CheckBoxControl, and SlickGroupBoxControl.

13.33.2.17 void GuiControl::SetControlIndex (K_UCHAR *ucIdx_*) [inline]

Set the index of the control, used for cycling through focus (ala tab order in VB).

Parameters

*ucIdx_*	Focus index of the control

Definition at line 606 of file gui.h.

13.33.2.18 void GuiControl::SetHeight (K_USHORT *usHeight_*) [inline]

Set the height of the control (in pixels)

Parameters

*usHeight_*	Height of the control in pixels

Definition at line 584 of file gui.h.

13.33.2.19 void GuiControl::SetLeft (K_USHORT *usLeft_*) [inline]

Set the location of the leftmost pixel of the control.

Parameters

*usLeft_*	Leftmost pixel of the control

Definition at line 577 of file gui.h.

13.33.2.20 void GuiControl::SetParentControl (GuiControl * *pclParent_*) [inline], [protected]

Set the parent control of this control.

When a control has its parent set, it is considered "nested" within that control. Moving the control will thus result in all of its child controls to become invalidated, thus requiring redraws. The control's object offsets (Top, Bottom, Height, and Width) also become relative to the origin of the parent control.

Parameters

*pclParent_*	Pointer to the control's parent control

Definition at line 706 of file gui.h.

13.33.2.21 void GuiControl::SetParentWindow (GuiWindow * *pclWindow_*) [inline], [protected]

Set the parent window of this control.

All controls within the same window are all associated together, and share events targetted towards a specific window. Event tabbing, focus, and Z-ordering is also shared between controls within a window.

Parameters

*pclWindow_*	Pointer to the control's parent window.

Definition at line 717 of file gui.h.

13.33.2.22 void GuiControl::SetTop (K_USHORT *usTop_*) [inline]

Set the location of the topmost pixel of the control.

Parameters

*usTop_*	Topmost pixel of the control

Definition at line 570 of file gui.h.

13.33.2.23 void GuiControl::SetWidth (K_USHORT *usWidth_*) [inline]

Set the width of the control (in pixels)

Parameters

*usWidth_*	Width of the control in pixels

Definition at line 591 of file gui.h.

13.33.2.24 void GuiControl::SetZOrder (K_UCHAR *ucZ_*) [inline]

Set the Z-order (depth) of the control.

Parameters

*ucZ_*	Z order of the control

Definition at line 598 of file gui.h.

13.33.3 Member Data Documentation

13.33.3.1 K_UCHAR GuiControl::m_ucControlIndex [private]

Index of the control in the window.

This is used for setting focus when transitioning from control to control on a window

Definition at line 770 of file gui.h.

13.33.3.2 K_UCHAR GuiControl::m_ucZOrder [private]

The Z-Order (depth) of the control.

Only the highest order controls are visible at any given location

Definition at line 766 of file gui.h.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/gui.h
- /home/moslevin2/mark3/embedded/stage/src/gui.cpp

13.34 GuiEvent_t Struct Reference

Composite UI event structure.

`#include <gui.h>`

Public Attributes

- K_UCHAR ucEventType
  GuiEventType_t event type.
- K_UCHAR ucTargetID
  Control index that this event is targeted towards.
- union {
  KeyEvent_t stKey
  Keyboard data.
  MouseEvent_t stMouse
  Mouse data.
  TouchEvent_t stTouch
  Touchscreen data.
  JoystickEvent_t stJoystick
  Joystick data.
  TimerEvent_t stTimer
  Timer data.
  };

13.34.1 Detailed Description

Composite UI event structure.

Depending on the event type, can contain either a keyboard, mouse, touch, joystick, timer event, etc.

Definition at line 187 of file gui.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/gui.h

13.35 GuiEventSurface Class Reference

GUI Event Surface Object.

`#include <gui.h>`

Public Member Functions

- void Init ()

  Initialize an event surface before use.
- void AddWindow (GuiWindow *pclWindow_)

  Add a window to the event surface.
- void RemoveWindow (GuiWindow *pclWindow_)

  Remove a window from the event surface.
- K_BOOL SendEvent (GuiEvent_t *pstEvent_)

  Send an event to this window surface.
- K_BOOL ProcessEvent ()

  Process an event in the event queue.
- K_UCHAR GetEventCount ()

  Get the count of pending events in the event surface's queue.
- GuiWindow * FindWindowByName (const K_CHAR *szName_)

  Return a pointer to a window by name, or NULL on failure.
- void InvalidateRegion (K_USHORT usLeft_, K_USHORT usTop_, K_USHORT usWidth_, K_USHORT usHeight_)

  Invalidate a region of the window, specified by the bounding box.

Private Member Functions

- void CopyEvent (GuiEvent_t *pstDst_, GuiEvent_t *pstSrc_)

  Copy the contents of one message structure to another.

Private Attributes

- DoubleLinkList m_clWindowList

  List of windows managed on this event surface.
- MessageQueue m_clMessageQueue

  Message queue used to manage window events.

13.35.1 Detailed Description

GUI Event Surface Object.

An event surface is the lowest-level UI object. It maintains a list of windows which are associated with it, and manages the transmission and routing of events to each window, and their appropriate controls

All windows located on the event surface are assumed to share a common display, and coordinate frame. In this way, multiple GUIs can be implemented in the system, each tied to separate physical or virtual displays.

Definition at line 452 of file gui.h.

13.35.2 Member Function Documentation

13.35.2.1 void GuiEventSurface::AddWindow (GuiWindow * *pclWindow_*)

Add a window to the event surface.

Parameters

*pclWindow_*	Pointer to the window object to add to the sruface

Definition at line 525 of file gui.cpp.

13.35.2.2 void GuiEventSurface::CopyEvent (GuiEvent_t * *pstDst_*, GuiEvent_t * *pstSrc_*) [private]

Copy the contents of one message structure to another.

Parameters

*pstDst_*	Destination event pointer
*pstSrc_*	Source event pointer

Definition at line 645 of file gui.cpp.

13.35.2.3 void GuiEventSurface::Init ( ) [inline]

Initialize an event surface before use.

Must be called prior to any other object methods.

Definition at line 459 of file gui.h.

13.35.2.4 void GuiEventSurface::InvalidateRegion (K_USHORT *usLeft_*, K_USHORT *usTop_*, K_USHORT *usWidth_*, K_USHORT *usHeight_*)

Invalidate a region of the window, specified by the bounding box.

The coordinates specified in the parameters (top and left) refer to absolute display coordinates, and are not relative to coordinates within a window.

Definition at line 658 of file gui.cpp.

13.35.2.5 K_BOOL GuiEventSurface::ProcessEvent ( )

Process an event in the event queue.

If no events are pending, the call will block until an event is available.

Definition at line 577 of file gui.cpp.

13.35.2.6 void GuiEventSurface::RemoveWindow (GuiWindow * *pclWindow_*)

Remove a window from the event surface.

Parameters

*pclWindow_*	Pointer to the window object to remove from the surface

Definition at line 533 of file gui.cpp.

13.35.2.7 K_BOOL GuiEventSurface::SendEvent (GuiEvent_t * *pstEvent_*)

Send an event to this window surface.

The event will be forwraded to all windows managed by this service.

Parameters

*pstEvent_*	Pointer to an event to send

Returns

true on success, false on failure

Definition at line 541 of file gui.cpp.

The documentation for this class was generated from the following files:

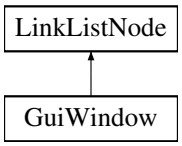
- /home/moslevin2/mark3/embedded/stage/src/gui.h
- /home/moslevin2/mark3/embedded/stage/src/gui.cpp

13.36 GuiWindow Class Reference

Basic Window Class.

`#include <gui.h>`

Inheritance diagram for GuiWindow:



Public Member Functions

- void Init ()

  Initialize the GUI Window object prior to use.
- void SetDriver (GraphicsDriver *pclDriver_)

  Set the graphics driver to use for rendering controls on the window.
- GraphicsDriver * GetDriver ()

  Set the graphics driver to use for rendering controls on the window.
- void AddControl (GuiControl *pclControl_, GuiControl *pclParent_)

  Assign a GUI Control to this window object.

- void RemoveControl (GuiControl *pclControl_)

  Removes a previously-added control from the Window.
- K_UCHAR GetMaxZOrder ()

  Returns the highest Z-Order of all controls attached to this window.
- void Redraw (K_BOOL bRedrawAll_)

  Redraw objects in the window.
- void ProcessEvent (GuiEvent_t *pstEvent_)

  Process an event sent to this window.
- void SetFocus (GuiControl *pclControl_)

  Set the control used to accept "focus" events.
- K_BOOL IsInFocus (GuiControl *pclControl_)

  Return whether or not the selected control is in focus or not.
- void SetTop (K_USHORT usTop_)

  Set the location of the topmost pixel of the window.
- void SetLeft (K_USHORT usLeft_)

  Set the location of the leftmost pixel of the window.
- void SetHeight (K_USHORT usHeight_)

  Set the height of the window (in pixels)
- void SetWidth (K_USHORT usWidth_)

  Set the width of the window (in pixels)
- K_USHORT GetTop ()

  Return the topmost pixel of the window.
- K_USHORT GetLeft ()

  Return the leftmost pixel of the window.
- K_USHORT GetHeight ()

  Get the height of the window in pixels.
- K_USHORT GetWidth ()

  Get the width of the window in pixels.
- K_UCHAR GetZOrder ()

  Get the Z-order of the window on the event surface.
- void SetZOrder (K_UCHAR ucZ_)

  Set the Z-order of the window on the event surface.
- void CycleFocus (bool bForward_)

  Cycle the focus to the next active control in the window.
- void SetName (const K_CHAR *szName_)

  Set the name for this window.
- const K_CHAR * GetName ()

  Return the name of this window.
- void InvalidateRegion (K_USHORT usLeft_, K_USHORT usTop_, K_USHORT usWidth_, K_USHORT usHeight_)

  Invalidate a region of the window, specified by the bounding box.

Private Attributes

- K_USHORT m_usTop

  Topmost pixel of the window on the event surface.
- K_USHORT m_usLeft

  Leftmost pixel of the window on the event surface.
- K_USHORT m_usHeight

  Height of the window in pixels.

- K_USHORT m_usWidth

  Width of the window in pixels.
- K_UCHAR m_ucZ

  Z-order of the window on the event surface.
- const K_CHAR * m_szName

  Name applied to this window.
- DoubleLinkList m_clControlList

  List of controls managed by this window.
- GuiControl * m_pclInFocus

  Pointer to the control in event focus.
- K_UCHAR m_ucControlCount

  Number of controls in this window.
- GraphicsDriver * m_pclDriver

  Graphics driver for this window.

Additional Inherited Members

13.36.1 Detailed Description

Basic Window Class.

A Window is loosely defined as a container of controls, all sharing a coordinate reference coordinate frame. Events are managed on a per-window basis, and each window is isolated from eachother.

Definition at line 223 of file gui.h.

13.36.2 Member Function Documentation

13.36.2.1 GuiWindow::AddControl (GuiControl * *pclControl_*, GuiControl * *pclParent_*)

Assign a GUI Control to this window object.

Adding an object to a window ensures that the object will be drawn on the specific window surface, and ensures that events directed to this window will be forwarded to the controls appropriately.

Parameters

*pclControl_*	Pointer to the control object to add
*pclParent_*	Pointer to the control's "parent" object (or NULL)

Definition at line 27 of file gui.cpp.

13.36.2.2 void GuiWindow::CycleFocus (bool *bForward_*)

Cycle the focus to the next active control in the window.

Parameters

*bForward_*	- Cycle to the next control when true, previous control when false

Definition at line 395 of file gui.cpp.

13.36.2.3 GraphicsDriver * GuiWindow::GetDriver ( ) [inline]

Set the graphics driver to use for rendering controls on the window.

Returns

Pointer to the Window's graphics driver

Definition at line 252 of file gui.h.

13.36.2.4 K_USHORT GuiWindow::GetHeight ( ) [inline]

Get the height of the window in pixels.

Returns

Height of the window in pixels

Definition at line 379 of file gui.h.

13.36.2.5 K_USHORT GuiWindow::GetLeft ( ) [inline]

Return the leftmost pixel of the window.

Returns

Leftmost pixel of the window

Definition at line 372 of file gui.h.

13.36.2.6 K_UCHAR GuiWindow::GetMaxZOrder ( )

Returns the highest Z-Order of all controls attached to this window.

Returns

The highest Z-Order used by controls in this window

Definition at line 61 of file gui.cpp.

13.36.2.7 K_USHORT GuiWindow::GetTop ( ) [inline]

Return the topmost pixel of the window.

Returns

Topmost pixel of the window

Definition at line 365 of file gui.h.

13.36.2.8 K_USHORT GuiWindow::GetWidth ( ) [inline]

Get the width of the window in pixels.

Returns

Width of the window in pixels

Definition at line 386 of file gui.h.

13.36.2.9 void GuiWindow::Init ( ) [inline]

Initialize the GUI Window object prior to use.

Must be called before calling other methods on this object

Definition at line 231 of file gui.h.

13.36.2.10 void GuiWindow::InvalidateRegion (K_USHORT *usLeft_*, K_USHORT *usTop_*, K_USHORT *usWidth_*, K_USHORT *usHeight_*)

Invalidate a region of the window, specified by the bounding box.

The coordinates specified in the parameters (top and left) refer to absolute display coordinates, and are not relative to coordinates within a window.

Definition at line 127 of file gui.cpp.

13.36.2.11 K_BOOL GuiWindow::IsInFocus (GuiControl * *pclControl_*) [inline]

Return whether or not the selected control is in focus or not.

Parameters

*pclControl_*	Pointer to the control object to evaluate

Returns

true - the selected control is the active control on the window false - otherwise

Definition at line 323 of file gui.h.

13.36.2.12 void GuiWindow::ProcessEvent (GuiEvent_t * *pstEvent_*)

Process an event sent to this window.

This method handles all of the plumbing required to target the event towards specific controls, or all controls in the window depending on the event payload.

Definition at line 245 of file gui.cpp.

13.36.2.13 void GuiWindow::Redraw (K_BOOL *bRedrawAll_*)

Redraw objects in the window.

Typically, only the affected controls will need to be redrawn, but in some cases (such as window initialization), the entire window will need to be redrawn cleanly. This behavior is defined by the value of the bRedrawAll_ parameter.

Definition at line 85 of file gui.cpp.

13.36.2.14 GuiWindow::RemoveControl (GuiControl * *pclControl_*)

Removes a previously-added control from the Window.

Parameters

*pclControl_*	Pointer to the control object to remove

Definition at line 40 of file gui.cpp.

13.36.2.15 void GuiWindow::SetDriver (GraphicsDriver * *pclDriver_*) [inline]

Set the graphics driver to use for rendering controls on the window.

Parameters

*pclDriver_*	Pointer to the graphics driver

Definition at line 244 of file gui.h.

13.36.2.16 void GuiWindow::SetFocus (GuiControl * *pclControl_*)

Set the control used to accept "focus" events.

Such events include keyboard events.

Parameters

*pclControl_*	Pointer to the control object to set focus on.

Definition at line 387 of file gui.cpp.

13.36.2.17 void GuiWindow::SetHeight (K_USHORT *usHeight_*) [inline]

Set the height of the window (in pixels)

Parameters

*usHeight_*	Height of the window in pixels

Definition at line 351 of file gui.h.

13.36.2.18 void GuiWindow::SetLeft (K_USHORT *usLeft_*) [inline]

Set the location of the leftmost pixel of the window.

Parameters

*usLeft_*	Leftmost pixel of the window

Definition at line 344 of file gui.h.

13.36.2.19 void GuiWindow::SetTop (K_USHORT *usTop_*) [inline]

Set the location of the topmost pixel of the window.

Parameters

*usTop_*	Topmost pixel of the window

Definition at line 337 of file gui.h.

13.36.2.20 void GuiWindow::SetWidth (K_USHORT *usWidth_*) [inline]

Set the width of the window (in pixels)

Parameters

*usWidth_*	Width of the window in pixels

Definition at line 358 of file gui.h.

13.36.3 Member Data Documentation

13.36.3.1 GraphicsDriver* GuiWindow::m_pclDriver [private]

Graphics driver for this window.

Definition at line 436 of file gui.h.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/gui.h
- /home/moslevin2/mark3/embedded/stage/src/gui.cpp

13.37 HeapConfig Class Reference

Heap configuration object.

`#include <fixed_heap.h>`

Public Attributes

- K_USHORT m_usBlockSize

  Block size in bytes.
- K_USHORT m_usBlockCount

  Number of blocks to create @ this size.

Protected Attributes

- BlockHeap m_clHeap

  BlockHeap object used by the allocator.

Friends

- class **FixedHeap**

13.37.1 Detailed Description

Heap configuration object.

Definition at line 90 of file fixed_heap.h.

The documentation for this class was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/fixed_heap.h

13.38 JoystickEvent_t Struct Reference

Joystick UI event structure.

`#include <gui.h>`

Public Attributes

- union {
  K_USHORT usRawData
  Raw joystick data.
  struct {
  unsigned int bUp:1
  D-pad UP state.
  unsigned int bDown:1
  D-pad DOWN state.
  unsigned int bLeft:1
  D-pad LEFT state.
  unsigned int bRight:1
  D-pad RIGHT state.
  unsigned int bButton1:1
  Joystick Button1 state.
  unsigned int bButton2:1
  Joystick Button2 state.
  unsigned int bButton3:1
  Joystick Button3 state.
  unsigned int bButton4:1
  Joystick Button4 state.
  unsigned int bButton5:1
  Joystick Button5 state.
  unsigned int bButton6:1
  Joystick Button6 state.
  unsigned int bButton7:1
  Joystick Button7 state.
  unsigned int bButton8:1
  Joystick Button8 state.
  unsigned int bButton9:1
  Joystick Button9 state.
  unsigned int bButton10:1
  Joystick Button10 state.
  unsigned int bSelect:1
  Start button state.
  unsigned int bStart:1
  Select button state.
  }
  };

13.38.1 Detailed Description

Joystick UI event structure.

Definition at line 144 of file gui.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/gui.h

13.39 Kernel Class Reference

Class that encapsulates all of the kernel startup functions.

`#include <kernel.h>`

Static Public Member Functions

- static void Init (void)

  Kernel Initialization Function, call before any other OS function.
- static void Start (void)

  Start the kernel; function never returns.
- static bool IsStarted ()

  IsStarted.

Static Private Attributes

- static bool **m_bIsStarted**

13.39.1 Detailed Description

Class that encapsulates all of the kernel startup functions.

Definition at line 40 of file kernel.h.

13.39.2 Member Function Documentation

13.39.2.1 Kernel::Init (void) [static]

Kernel Initialization Function, call before any other OS function.

Initializes all global resources used by the operating system. This must be called before any other kernel function is invoked.

Definition at line 45 of file kernel.cpp.

13.39.2.2 static bool Kernel::IsStarted ( ) [inline], [static]

IsStarted.

Returns

Whether or not the kernel has started - true = running, false = not started

Definition at line 72 of file kernel.h.

13.39.2.3 Kernel::Start (void) [static]

Start the kernel; function never returns.

Start the operating system kernel - the current execution context is cancelled, all kernel services are started, and the processor resumes execution at the entrypoint for the highest-priority thread.

You must have at least one thread added to the kernel before calling this function, otherwise the behavior is undefined.

Definition at line 71 of file kernel.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/kernel.h
- /home/moslevin2/mark3/embedded/stage/src/kernel.cpp

13.40 KernelSWI Class Reference

Class providing the software-interrupt required for context-switching in the kernel.

`#include <kernelswi.h>`

Static Public Member Functions

- static void Config (void)

  Configure the software interrupt - must be called before any other software interrupt functions are called.
- static void Start (void)

  Enable ("Start") the software interrupt functionality.
- static void Stop (void)

  Disable the software interrupt functionality.
- static void Clear (void)

  Clear the software interrupt.
- static void Trigger (void)

  Call the software interrupt.
- static K_UCHAR DI ()

  Disable the SWI flag itself.
- static void RI (K_UCHAR bEnable_)

  Restore the state of the SWI to the value specified.

13.40.1 Detailed Description

Class providing the software-interrupt required for context-switching in the kernel.

Definition at line 32 of file kernelswi.h.

13.40.2 Member Function Documentation

13.40.2.1 K_UCHAR KernelSWI::DI ( ) [static]

Disable the SWI flag itself.

Returns

previous status of the SWI, prior to the DI call

Definition at line 50 of file kernelswi.cpp.

13.40.2.2 void KernelSWI::RI (K_UCHAR *bEnable_*) [static]

Restore the state of the SWI to the value specified.

Parameters

*bEnable_*	true - enable the SWI, false - disable SWI

Definition at line 58 of file kernelswi.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/kernelswi.h
- /home/moslevin2/mark3/embedded/stage/src/kernelswi.cpp

13.41 KernelTimer Class Reference

Hardware timer interface, used by all scheduling/timer subsystems.

`#include <kerneltimer.h>`

Static Public Member Functions

- static void Config (void)

  Initializes the kernel timer before use.
- static void Start (void)

  Starts the kernel time (must be configured first)
- static void Stop (void)

  Shut down the kernel timer, used when no timers are scheduled.
- static K_UCHAR DI (void)

  Disable the kernel timer's expiry interrupt.
- static void RI (K_UCHAR bEnable_)

  Retstore the state of the kernel timer's expiry interrupt.
- static void EI (void)

  Enable the kernel timer's expiry interrupt.
- static K_ULONG SubtractExpiry (K_ULONG ulInterval_)

  Subtract the specified number of ticks from the timer's expiry count register.
- static K_ULONG TimeToExpiry (void)

  Returns the number of ticks remaining before the next timer expiry.
- static K_ULONG SetExpiry (K_ULONG ulInterval_)

  Resets the kernel timer's expiry interval to the specified value.
- static K_ULONG GetOvertime (void)

  Return the number of ticks that have elapsed since the last expiry.
- static void ClearExpiry (void)

  Clear the hardware timer expiry register.

Static Private Member Functions

- static K_USHORT Read (void)

  Safely read the current value in the timer register.

13.41.1 Detailed Description

Hardware timer interface, used by all scheduling/timer subsystems.

Definition at line 33 of file kerneltimer.h.

13.41.2 Member Function Documentation

13.41.2.1 K_ULONG KernelTimer::GetOvertime (void) [static]

Return the number of ticks that have elapsed since the last expiry.

Returns

Number of ticks that have elapsed after last timer expiration

Definition at line 94 of file kerneltimer.cpp.

13.41.2.2 K_USHORT KernelTimer::Read (void) [static], [private]

Safely read the current value in the timer register.

Returns

Value held in the timer register

Definition at line 57 of file kerneltimer.cpp.

13.41.2.3 void KernelTimer::RI (K_UCHAR *bEnable_*) [static]

Retstore the state of the kernel timer's expiry interrupt.

Parameters

*bEnable_*	1 enable, 0 disable

Definition at line 137 of file kerneltimer.cpp.

13.41.2.4 K_ULONG KernelTimer::SetExpiry (K_ULONG *ullnterval_*) [static]

Resets the kernel timer's expiry interval to the specified value.

Parameters

*ullnterval_*	Desired interval in ticks to set the timer for

Returns

Actual number of ticks set (may be less than desired)

Definition at line 100 of file kerneltimer.cpp.

13.41.2.5 K_ULONG KernelTimer::SubtractExpiry (K_ULONG *ullnterval_*) [static]

Subtract the specified number of ticks from the timer's expiry count register.

Returns the new expiry value stored in the register.

Parameters

*ulInterval_*	Time (in HW-specific) ticks to subtract

Returns

Value in ticks stored in the timer's expiry register

Definition at line 71 of file kerneltimer.cpp.

13.41.2.6 K_ULONG KernelTimer::TimeToExpiry (void) [static]

Returns the number of ticks remaining before the next timer expiry.

Returns

Time before next expiry in platform-specific ticks

Definition at line 78 of file kerneltimer.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/kerneltimer.h
- /home/moslevin2/mark3/embedded/stage/src/kerneltimer.cpp

13.42 KeyEvent_t Struct Reference

Keyboard UI event structure definition.

`#include <gui.h>`

Public Attributes

- K_UCHAR ucKeyCode
  8-bit value representing a keyboard scan code
- union {
  K_UCHAR ucFlags
  Flags indicating modifiers to the event.
  struct {
  unsigned int bKeyState:1
  Key is being pressed or released.
  unsigned int bShiftState:1
  Whether or not shift is pressed.
  unsigned int bCtrlState:1
  Whether or not CTRL is pressed.
  unsigned int bAltState:1
  Whether or not ALT it pressed.
  unsigned int bWinState:1
  Whether or not the Window/Clover key is pressed.
  unsigned int bFnState:1
  Whether or not a special function key is pressed.
  }
  };

13.42.1 Detailed Description

Keyboard UI event structure definition.

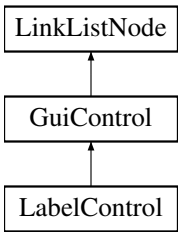
Definition at line 80 of file gui.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/gui.h

13.43 LabelControl Class Reference

Inheritance diagram for LabelControl:



Public Member Functions

- virtual void Init ()

  Initiailize the control - must be called before use.
- virtual void Draw ()

  Redraw the control "cleanly".
- virtual GuiReturn_t ProcessEvent (GuiEvent_t *pstEvent_)

  Process an event sent to the control.
- virtual void Activate (bool bActivate_)

  Activate or deactivate the current control - used when switching from one active control to another.
- void **SetBackColor** (COLOR eColor_)
- void **SetFontColor** (COLOR eColor_)
- void **SetFont** (Font_t *pstFont_)
- void **SetCaption** (const K_CHAR *pcData_)

Private Attributes

- Font_t * **m_pstFont**
- const K_CHAR * **m_pcCaption**
- COLOR **m_uBackColor**
- COLOR **m_uFontColor**

Additional Inherited Members

13.43.1 Detailed Description

Definition at line 30 of file control_label.h.

13.43.2 Member Function Documentation

13.43.2.1 virtual void LabelControl::Activate (bool *bActivate_*) [inline], [virtual]

Activate or deactivate the current control - used when switching from one active control to another.

Parameters

*bActivate_*	- true to activate, false to deactivate

Implements GuiControl.

Definition at line 40 of file control_label.h.

13.43.2.2 void LabelControl::Draw ( ) [virtual]

Redraw the control "cleanly".

Subclass specific.

Implements GuiControl.

Definition at line 26 of file control_label.cpp.

13.43.2.3 virtual void LabelControl::Init ( ) [inline], [virtual]

Initiailize the control - must be called before use.

Implementation is subclass specific.

Implements GuiControl.

Definition at line 33 of file control_label.h.

13.43.2.4 virtual GuiReturn_t LabelControl::ProcessEvent (GuiEvent_t * *pstEvent_*) [inline], [virtual]

Process an event sent to the control.

Subclass specific implementation.

Parameters

*pstEvent_*	Pointer to a struct containing the event data

Implements GuiControl.

Definition at line 39 of file control_label.h.

The documentation for this class was generated from the following files:

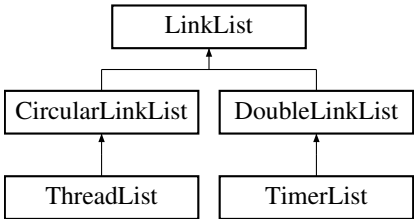
- /home/moslevin2/mark3/embedded/stage/src/control_label.h
- /home/moslevin2/mark3/embedded/stage/src/control_label.cpp

13.44 LinkList Class Reference

Abstract-data-type from which all other linked-lists are derived.

`#include <ll.h>`

Inheritance diagram for LinkList:



Public Member Functions

- void Init ()

  Clear the linked list.
- virtual void Add (LinkListNode *node_)=0

  Add the linked list node to this linked list.
- virtual void Remove (LinkListNode *node_)=0

  Add the linked list node to this linked list.
- LinkListNode * GetHead ()

  Get the head node in the linked list.
- LinkListNode * GetTail ()

  Get the tail node of the linked list.

Protected Attributes

- LinkListNode * m_pstHead

  Pointer to the head node in the list.
- LinkListNode * m_pstTail

  Pointer to the tail node in the list.

13.44.1 Detailed Description

Abstract-data-type from which all other linked-lists are derived.

Definition at line 117 of file ll.h.

13.44.2 Member Function Documentation

13.44.2.1 void LinkList::Add (LinkListNode * *node_*) [pure virtual]

Add the linked list node to this linked list.

Parameters

*node_*	Pointer to the node to add

Implemented in CircularLinkList, DoubleLinkList, and ThreadList.

13.44.2.2 LinkListNode * LinkList::GetHead ( ) [inline]

Get the head node in the linked list.

Returns

Pointer to the head node in the list

Definition at line 154 of file ll.h.

13.44.2.3 LinkListNode * LinkList::GetTail ( ) [inline]

Get the tail node of the linked list.

Returns

Pointer to the tail node in the list

Definition at line 163 of file ll.h.

13.44.2.4 void LinkList::Remove (LinkListNode * *node_*) [pure virtual]

Add the linked list node to this linked list.

Parameters

*node_*	Pointer to the node to remove

Implemented in CircularLinkList, DoubleLinkList, and ThreadList.

The documentation for this class was generated from the following file:

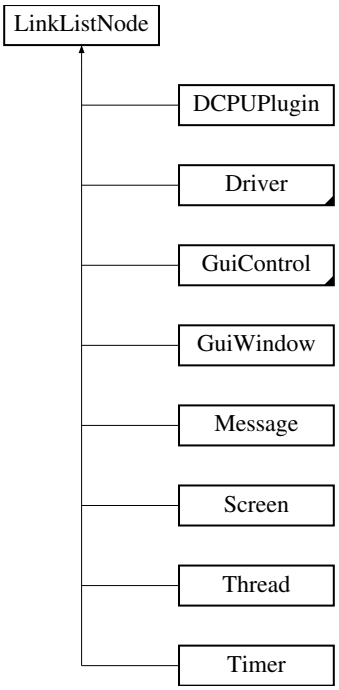
- /home/moslevin2/mark3/embedded/stage/src/ll.h

13.45 LinkListNode Class Reference

Basic linked-list node data structure.

`#include <ll.h>`

Inheritance diagram for LinkListNode:



Public Member Functions

- LinkListNode * GetNext (void)

  Returns a pointer to the next node in the list.
- LinkListNode * GetPrev (void)

  Returns a pointer to the previous node in the list.

Protected Member Functions

- void ClearNode ()

  Initialize the linked list node, clearing its next and previous node.

Protected Attributes

- LinkListNode * next

  Pointer to the next node in the list.
- LinkListNode * prev

  Pointer to the previous node in the list.

Friends

- class **LinkList**
- class **DoubleLinkList**
- class **CircularLinkList**

13.45.1 Detailed Description

Basic linked-list node data structure.

This data is managed by the linked-list class types, and can be used transparently between them.

Definition at line 75 of file ll.h.

13.45.2 Member Function Documentation

13.45.2.1 LinkListNode * LinkListNode::GetNext (void) [inline]

Returns a pointer to the next node in the list.

Returns

a pointer to the next node in the list.

Definition at line 97 of file ll.h.

13.45.2.2 LinkListNode * LinkListNode::GetPrev (void) [inline]

Returns a pointer to the previous node in the list.

Returns

a pointer to the previous node in the list.

Definition at line 106 of file ll.h.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/ll.h
- /home/moslevin2/mark3/embedded/stage/src/ll.cpp

13.46 MemUtil Class Reference

String and Memory manipulation class.

`#include <memutil.h>`

Static Public Member Functions

- static void DecimalToHex (K_UCHAR ucData_, char *szText_)
  Convert an 8-bit unsigned binary value as a hexadecimal string.
- static void **DecimalToHex** (K_USHORT usData_, char *szText_)
- static void **DecimalToHex** (K_ULONG ulData_, char *szText_)
- static void DecimalToString (K_UCHAR ucData_, char *szText_)
  Convert an 8-bit unsigned binary value as a decimal string.
- static void **DecimalToString** (K_USHORT usData_, char *szText_)
- static void **DecimalToString** (K_ULONG ulData_, char *szText_)
- static K_UCHAR Checksum8 (const void *pvSrc_, K_USHORT usLen_)
  Compute the 8-bit addative checksum of a memory buffer.
- static K_USHORT Checksum16 (const void *pvSrc_, K_USHORT usLen_)
  Compute the 16-bit addative checksum of a memory buffer.
- static K_USHORT StringLength (const char *szStr_)
  Compute the length of a string in bytes.
- static bool CompareStrings (const char *szStr1_, const char *szStr2_)
  Compare the contents of two zero-terminated string buffers to eachother.
- static void CopyMemory (void *pvDst_, const void *pvSrc_, K_USHORT usLen_)
  Copy one buffer in memory into another.
- static void CopyString (char *szDst_, const char *szSrc_)

Copy a string from one buffer into another.

- static K_SHORT StringSearch (const char *szBuffer_, const char *szPattern_)

  Search for the presence of one string as a substring within another.
- static bool CompareMemory (const void *pvMem1_, const void *pvMem2_, K_USHORT usLen_)

  Compare the contents of two memory buffers to eachother.
- static void SetMemory (void *pvDst_, K_UCHAR ucVal_, K_USHORT usLen_)

  Initialize a buffer of memory to a specified 8-bit pattern.
- static K_UCHAR Tokenize (const char *szBuffer_, Token_t *pastTokens_, K_UCHAR ucMaxTokens_)

  Tokenize Function to tokenize a string based on a space delimeter.

13.46.1 Detailed Description

String and Memory manipulation class.

Utility method class implementing common memory and string manipulation functions, without relying on an external standard library implementation which might not be available on some toolchains, may be closed source, or may not be thread-safe.

Definition at line 47 of file memutil.h.

13.46.2 Member Function Documentation

13.46.2.1 static K_USHORT MemUtil::Checksum16 (const void * *pvSrc_*, K_USHORT *usLen_*) [static]

Compute the 16-bit addative checksum of a memory buffer.

Parameters

*pvSrc_*	Memory buffer to compute a 16-bit checksum of.
*usLen_*	Length of the buffer in bytes.

Returns

16-bit checksum of the memory block.

Definition at line 215 of file memutil.cpp.

13.46.2.2 static K_USHORT MemUtil::Checksum8 (const void * *pvSrc_*, K_USHORT *usLen_*) [static]

Compute the 8-bit addative checksum of a memory buffer.

Parameters

*pvSrc_*	Memory buffer to compute a 8-bit checksum of.
*usLen_*	Length of the buffer in bytes.

Returns

8-bit checksum of the memory block.

Definition at line 199 of file memutil.cpp.

13.46.2.3 static bool MemUtil::CompareMemory (const void * *pvMem1_*, const void * *pvMem2_*, K_USHORT *usLen_*) [static]

Compare the contents of two memory buffers to eachother.

Parameters

*pvMem1_*	First buffer to compare
*pvMem2_*	Second buffer to compare
*usLen_*	Length of buffer (in bytes) to compare

Returns

true if the buffers match, false if they do not.

Definition at line 342 of file memutil.cpp.

13.46.2.4 static bool MemUtil::CompareStrings (const char * *szStr1_*, const char * *szStr2_*) [static]

Compare the contents of two zero-terminated string buffers to eachother.

Parameters

*szStr1_*	First string to compare
*szStr2_*	Second string to compare

Returns

true if strings match, false otherwise.

Definition at line 247 of file memutil.cpp.

13.46.2.5 static void MemUtil::CopyMemory (void * *pvDst_*, const void * *pvSrc_*, K_USHORT *usLen_*) [static]

Copy one buffer in memory into another.

Parameters

*pvDst_*	Pointer to the destination buffer
*pvSrc_*	Pointer to the source buffer
*usLen_*	Number of bytes to copy from source to destination

Definition at line 273 of file memutil.cpp.

13.46.2.6 static void MemUtil::CopyString (char * *szDst_*, const char * *szSrc_*) [static]

Copy a string from one buffer into another.

Parameters

*szDst_*	Pointer to the buffer to copy into
*szSrc_*	Pointer to the buffer to copy data from

Definition at line 290 of file memutil.cpp.

13.46.2.7 static void MemUtil::DecimalToHex (K_UCHAR *ucData_*, char * *szText_*) [static]

Convert an 8-bit unsigned binary value as a hexadecimal string.

Parameters

*ucData_*	Value to convert into a string
*szText_*	Destination string buffer (3 bytes minimum)

Definition at line 28 of file memutil.cpp.

13.46.2.8 static void MemUtil::DecimalToString (K_UCHAR *ucData_*, char * *szText_*) [static]

Convert an 8-bit unsigned binary value as a decimal string.

Parameters

*ucData_*	Value to convert into a string
*szText_*	Destination string buffer (4 bytes minimum)

Definition at line 122 of file memutil.cpp.

13.46.2.9 static void MemUtil::SetMemory (void * *pvDst_*, K_UCHAR *ucVal_*, K_USHORT *usLen_*) [static]

Initialize a buffer of memory to a specified 8-bit pattern.

Parameters

*pvDst_*	Destination buffer to set
*ucVal_*	8-bit pattern to initialize each byte of destination with
*usLen_*	Length of the buffer (in bytes) to initialize

Definition at line 363 of file memutil.cpp.

13.46.2.10 static K_USHORT MemUtil::StringLength (const char * *szStr_*) [static]

Compute the length of a string in bytes.

Parameters

*szStr_*	Pointer to the zero-terminated string to calculate the length of

Returns

length of the string (in bytes), not including the 0-terminator.

Definition at line 232 of file memutil.cpp.

13.46.2.11 static K_SHORT MemUtil::StringSearch (const char * *szBuffer_*, const char * *szPattern_*) [static]

Search for the presence of one string as a substring within another.

Parameters

*szBuffer_*	Buffer to search for pattern within
*szPattern_*	Pattern to search for in the buffer

Returns

Index of the first instance of the pattern in the buffer, or -1 on no match.

Definition at line 307 of file memutil.cpp.

13.46.2.12 K_UCHAR MemUtil::Tokenize (const char * *szBuffer_*, Token_t * *pastTokens_*, K_UCHAR *ucMaxTokens_*) [static]

Tokenize Function to tokenize a string based on a space delimeter.

This is a non-destructive function, which populates a Token_t descriptor array.

Parameters

*szBuffer_*	String to tokenize
*pastTokens_*	Pointer to the array of token descriptors
*ucMaxTokens_*	Maximum number of tokens to parse (i.e. size of pastTokens_)

Returns

Count of tokens parsed

Definition at line 376 of file memutil.cpp.

The documentation for this class was generated from the following files:

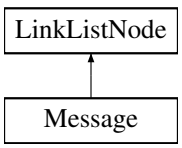
- /home/moslevin2/mark3/embedded/stage/src/memutil.h
- /home/moslevin2/mark3/embedded/stage/src/memutil.cpp

13.47 Message Class Reference

Class to provide message-based IPC services in the kernel.

`#include <message.h>`

Inheritance diagram for Message:



Public Member Functions

- void Init ()

Initialize the data and code in the message.

- void SetData (void *pvData_)

  Set the data pointer for the message before transmission.

- void * GetData ()

  Get the data pointer stored in the message upon receipt.

- void SetCode (K_USHORT usCode_)

  Set the code in the message before transmission.

- K_USHORT GetCode ()

  Return the code set in the message upon receipt.

Private Attributes

- void * m_pvData

  Pointer to the message data.

- K_USHORT m_usCode

  Message code, providing context for the message.

Additional Inherited Members

13.47.1 Detailed Description

Class to provide message-based IPC services in the kernel.

Definition at line 99 of file message.h.

13.47.2 Member Function Documentation

13.47.2.1 K_USHORT Message::GetCode ( ) [inline]

Return the code set in the message upon receipt.

Returns

User code set in the object

Definition at line 143 of file message.h.

13.47.2.2 void * Message::GetData ( ) [inline]

Get the data pointer stored in the message upon receipt.

Returns

Pointer to the data set in the message object

Definition at line 125 of file message.h.

13.47.2.3 Message::SetCode (K_USHORT *usCode_*) [inline]

Set the code in the message before transmission.

Parameters

*usCode_*	Data code to set in the object

Definition at line 134 of file message.h.

13.47.2.4 void Message::SetData (void * *pvData_*) [inline]

Set the data pointer for the message before transmission.

Parameters

*pvData_*	Pointer to the data object to send in the message

Definition at line 116 of file message.h.

The documentation for this class was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/message.h

13.48 MessageQueue Class Reference

List of messages, used as the channel for sending and receiving messages between threads.

`#include <message.h>`

Public Member Functions

- void Init ()

  Initialize the message queue prior to use.
- Message * Receive ()

  Receive a message from the message queue.
- Message * Receive (K_ULONG ulTimeWaitMS_)

  Receive a message from the message queue.
- void Send (Message *pclSrc_)

  Send a message object into this message queue.
- K_USHORT GetCount ()

  Return the number of messages pending in the "receive" queue.

Private Attributes

- Semaphore m_clSemaphore

  Counting semaphore used to manage thread blocking.
- DoubleLinkList m_clLinkList

  List object used to store messages.

13.48.1 Detailed Description

List of messages, used as the channel for sending and receiving messages between threads.

Definition at line 201 of file message.h.

13.48.2 Member Function Documentation

13.48.2.1 K_USHORT MessageQueue::GetCount ( )

Return the number of messages pending in the "receive" queue.

Returns

Count of pending messages in the queue.

Definition at line 149 of file message.cpp.

13.48.2.2 Message * MessageQueue::Receive ( )

Receive a message from the message queue.

If the message queue is empty, the thread will block until a message is available.

Returns

Pointer to a message object at the head of the queue

Definition at line 91 of file message.cpp.

13.48.2.3 Message * MessageQueue::Receive (K_ULONG *ulWaitTimeMS_*)

Receive a message from the message queue.

If the message queue is empty, the thread will block until a message is available for the duration specified. If no message arrives within that duration, the call will return with NULL.

Parameters

*ulWaitTimeMS_*	The amount of time in ms to wait for a message before timing out and unblocking the waiting thread.

Returns

Pointer to a message object at the head of the queue or NULL on timeout.

Definition at line 111 of file message.cpp.

13.48.2.4 void MessageQueue::Send (Message * *pclSrc_*)

Send a message object into this message queue.

Will un-block the first waiting thread blocked on this queue if that occurs.

Parameters

*pclSrc_*	Pointer to the message object to add to the queue

Definition at line 133 of file message.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/message.h
- /home/moslevin2/mark3/embedded/stage/src/message.cpp

13.49 MouseEvent_t Struct Reference

Mouse UI event structure.

`#include <gui.h>`

Public Attributes

- K_USHORT usX

  absolute X location of the mouse (pixel)
- K_USHORT usY

  absolute Y location of the mouse (pixel)
- union {
  K_UCHAR ucFlags
  modifier flags for the event
  struct {
  unsigned int bLeftState:1
  State of the left mouse button.
  unsigned int bRightState:1
  State of the right mouse button.
  unsigned int bMiddleState:1
  State of the middle mouse button.
  unsigned int bScrollUp:1
  State of the scroll wheel (UP)
  unsigned int bScrollDown:1
  State of the scroll wheel (DOWN)
  }
  };

13.49.1 Detailed Description

Mouse UI event structure.

Definition at line 102 of file gui.h.

The documentation for this struct was generated from the following file:

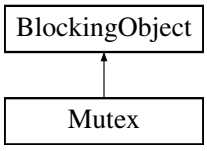
- /home/moslevin2/mark3/embedded/stage/src/gui.h

13.50 Mutex Class Reference

Mutual-exclusion locks, based on BlockingObject.

`#include <mutex.h>`

Inheritance diagram for Mutex:



Public Member Functions

- void Init ()

  Initialize a mutex object for use - must call this function before using the object.
- void Claim ()

  Claim the mutex.
- bool Claim (K_ULONG ulWaitTimeMS_)
- void WakeMe (Thread *pclOwner_)

  Wake a thread blocked on the mutex.
- void SetExpired (bool bExpired_)

  SetExpired Set the expired state of the mutex.
- void Release ()

  Release the mutex.

Private Member Functions

- K_UCHAR WakeNext ()

  Wake the next thread waiting on the Mutex.

Private Attributes

- K_UCHAR m_bReady

  State of the mutex - true = ready, false = claimed.
- K_UCHAR m_ucMaxPri

  Maximum priority of thread in queue, used for priority inheritence.
- Thread * m_pclOwner

  Pointer to the thread that owns the mutex (when claimed)
- bool m_bExpired

  Whether or not a timed mutex has expired (true = expired)

Additional Inherited Members

13.50.1 Detailed Description

Mutual-exclusion locks, based on BlockingObject.

Definition at line 68 of file mutex.h.

13.50.2 Member Function Documentation

13.50.2.1 void Mutex::Claim ( )

Claim the mutex.

When the mutex is claimed, no other thread can claim a region protected by the object.

Definition at line 96 of file mutex.cpp.

13.50.2.2 bool Mutex::Claim (K_ULONG *ulWaitTimeMS_*)

Parameters

*ulWaitTimeMS_*	

Returns

true - mutex was claimed within the time period specified false - mutex operation timed-out before the claim operation.

Definition at line 100 of file mutex.cpp.

13.50.2.3 void Mutex::Release ( )

Release the mutex.

When the mutex is released, another object can enter the mutex-protected region.

Definition at line 190 of file mutex.cpp.

13.50.2.4 void Mutex::SetExpired (bool *bExpired_*) [inline]

SetExpired Set the expired state of the mutex.

Used by the internal timer-related functions of the kernel - not for use by app code.

Parameters

*bExpired_*	true = expired, false = not expired

Definition at line 118 of file mutex.h.

13.50.2.5 void Mutex::WakeMe (Thread * *pclOwner_*)

Wake a thread blocked on the mutex.

This is an internal function used for implementing timed mutexes relying on timer callbacks. Since these do not have access to the private data of the mutex and its base classes, we have to wrap this as a public method - do not use this for any other purposes.

Parameters

*pclOwner_*	Thread to unblock from this object.

Definition at line 55 of file mutex.cpp.

The documentation for this class was generated from the following files:

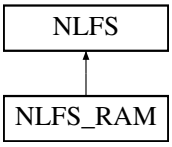
- /home/moslevin2/mark3/embedded/stage/src/mutex.h
- /home/moslevin2/mark3/embedded/stage/src/mutex.cpp

13.51 NLFS Class Reference

Nice Little File System class.

`#include <nlfs.h>`

Inheritance diagram for NLFS:



Public Member Functions

- void Format (NLFS_Host_t *puHost_, K_ULONG ulTotalSize_, K_USHORT usNumFiles_, K_USHORT usDataBlockSize_)

  Format/Create a new filesystem with the configuration specified in the parameters.
- void Mount (NLFS_Host_t *puHost_)

  Re-mount a previously-cerated filesystem using this FS object.
- K_USHORT Create_File (const K_CHAR *szPath_)

  Create_File creates a new file object at the specified path.
- K_USHORT Create_Dir (const K_CHAR *szPath_)

  Create_Dir creates a new directory at the specified path.
- K_USHORT Delete_File (const K_CHAR *szPath_)

  Delete_File Removes a file from disk.
- K_USHORT Delete_Folder (const K_CHAR *szPath_)

  Delete_Folder Remove a folder from disk.
- void Cleanup_Node_Links (K_USHORT usNode_, NLFS_Node_t *pstNode_)

  Cleanup_Node_Links Remove the links between the given node and its parent/peer nodes.
- K_USHORT Find_Parent_Dir (const K_CHAR *szPath_)

  Find_Parent_Dir returns the directory under which the specified file object lives.
- K_USHORT Find_File (const K_CHAR *szPath_)

  Find_File returns the file node ID of the object at a given path.
- void Print (void)

  Print displays a summary of files in the filesystem.
- K_ULONG GetBlockSize (void)

  GetBlockSize retrieves the data block size for the filesystem.
- K_ULONG GetNumBlocks (void)

  GetNumBlocks retrieves the number of data blocks in the filesystem.
- K_ULONG GetNumBlocksFree (void)

  GetNumBlocksFree retrieves the number of free data blocks in the filesystem.
- K_ULONG GetNumFiles (void)

  GetNumFiles retrieves the maximum number of files in the filesystem.
- K_USHORT GetNumFilesFree (void)

  GetNumFilesFree retrieves the number of free blocks in the filesystem.
- K_USHORT GetFirstChild (K_USHORT usNode_)

  GetFirstChild Return the first child node for a node representing a directory.
- K_USHORT GetNextPeer (K_USHORT usNode_)

  GetNextPeer Return the Node ID of a File/Directory's next peer.
- K_BOOL GetStat (K_USHORT usNode_, NLFS_File_Stat_t *pstStat_)

  GetStat Get the status of a file on-disk.

Protected Member Functions

- K_CHAR Find_Last_Slash (const K_CHAR *szPath_)

  Find_Last_Slash Finds the location of the last '/' character in a path.
- K_BOOL File_Names_Match (const K_CHAR *szPath_, NLFS_Node_t *pstNode_)

  File_Names_Match Determines if a given path matches the name in a file node.
- virtual void Read_Node (K_USHORT usNode_, NLFS_Node_t *pstNode_)=0

  Read_Node is an implementation-specific method used to read a file node from physical storage into a local data struture.
- virtual void Write_Node (K_USHORT usNode_, NLFS_Node_t *pstNode_)=0

  Write_Node is an implementation-specific method used to write a file node from a local structure back to the physical storage.
- virtual void Read_Block_Header (K_ULONG ulBlock_, NLFS_Block_t *pstBlock_)=0

  Read_Block_Header is an implementation-specific method used to read a file block header from physical storage into a local struct.
- virtual void Write_Block_Header (K_ULONG ulBlock_, NLFS_Block_t *pstFileBlock_)=0

  Write_Block_Header is an implementation-specific method used to write a file block header back to physical storage from a local struct.
- virtual void Read_Block (K_ULONG ulBlock_, K_ULONG ulOffset_, void *pvData_, K_ULONG ulLen_)=0

  Read_Block is an implementation-specific method used to read raw file data from physical storage into a local buffer.
- virtual void Write_Block (K_ULONG ulBlock_, K_ULONG ulOffset_, void *pvData_, K_ULONG ulLen_)=0

  Write_Block is an implementation-specific method used to write a piece of file data to its data block in the underlying physical storage.
- void RootSync ()

  RootSync Synchronize the filesystem config in the object back to the underlying storage mechanism.
- void Repair ()

  Repair Checks a filesystem for inconsistencies and makes repairs in order to avoid losing storage blocks.
- void Print_Free_Details (K_USHORT usNode_)

  Print_Free_Details Print details about a free node.
- void Print_File_Details (K_USHORT usNode_)

  Print_File_Details displays information about a given file node.
- void Print_Dir_Details (K_USHORT usNode_)

  Print_Dir_Details displays information about a given directory node.
- void Print_Node_Details (K_USHORT usNode_)

  Print_Node_Details prints details about a node, the details differ based on whether it's a file/directory/root node.
- void Push_Free_Node (K_USHORT usNode_)

  Push_Free_Node returns a file node back to the free node list.
- K_USHORT Pop_Free_Node (void)

  Pop_Free_Node returns the first free file node in the free list.
- void Push_Free_Block (K_ULONG ulBlock_)

  Push_Free_Block returns a file block back to the head of the free block list.
- K_ULONG Pop_Free_Block (void)

  Pop_Free_Block pops a file data block from the head of the free list.
- K_ULONG Append_Block_To_Node (NLFS_Node_t *pstFile_)

  Append_Block_To_Node adds a file data block to the end of a file.
- K_USHORT Create_File_i (const K_CHAR *szPath_, NLFS_Type_t eType_)

  Create_File_i is the private method used to create a file or directory.
- void Set_Node_Name (NLFS_Node_t *pstFileNode_, const K_CHAR *szPath_)

  Set_Node_Name sets the name of a file or directory node.

Protected Attributes

- NLFS_Host_t * m_puHost

  Local, cached copy of host FS pointer.
- NLFS_Root_Node_t m_stLocalRoot

  Local, cached copy of root.

Friends

- class **NLFS_File**

13.51.1 Detailed Description

Nice Little File System class.

Definition at line 280 of file nlfs.h.

13.51.2 Member Function Documentation

13.51.2.1 K_ULONG NLFS::Append_Block_To_Node (NLFS_Node_t * *pstFile_*) [protected]

Append_Block_To_Node adds a file data block to the end of a file.

Parameters

in	*pstFile_*	- Pointer to the file node to add a block to

Returns

Data block ID of the allocated block, or INVALID_BLOCK on failure.

Definition at line 245 of file nlfs.cpp.

13.51.2.2 void NLFS::Cleanup_Node_Links (K_USHORT *usNode_*, NLFS_Node_t * *pstNode_*)

Cleanup_Node_Links Remove the links between the given node and its parent/peer nodes.

Parameters

*usNode_*	Index of the node
*pstNode_*	Pointer to a local copy of the node data

Definition at line 598 of file nlfs.cpp.

13.51.2.3 K_USHORT NLFS::Create_Dir (const K_CHAR * *szPath_*)

Create_Dir creates a new directory at the specified path.

Parameters

in	*szPath_*	- Path to the directory to create

Returns

ID of the created dir, or INVALID_NODE if the path cannot be resolved, or the file already exists.

Definition at line 586 of file nlfs.cpp.

13.51.2.4 K_USHORT NLFS::Create_File (const K_CHAR * *szPath_*)

Create_File creates a new file object at the specified path.

Parameters

in	*szPath_*	- Path to the file to create

Returns

ID of the created file, or INVALID_NODE if the path cannot be resolved, or the file already exists.

Definition at line 573 of file nlfs.cpp.

13.51.2.5 K_USHORT NLFS::Create_File_i (const K_CHAR * *szPath_*, NLFS_Type_t *eType_*) [protected]

Create_File_i is the private method used to create a file or directory.

Parameters

in	*szPath_*	- Path of the file or directory to create
in	*eType_*	- Type of file to create

Returns

File node ID of the newly created file, or INVALID_NODE on failure.

! ToDo - set real user/group IDs

Definition at line 490 of file nlfs.cpp.

13.51.2.6 K_USHORT NLFS::Delete_File (const K_CHAR * *szPath_*)

Delete_File Removes a file from disk.

Parameters

*szPath_*	Path of the file to remove

Returns

Index of the node deleted or INVALID_NODE on error

Definition at line 705 of file nlfs.cpp.

13.51.2.7 K_USHORT NLFS::Delete_Folder (const K_CHAR * *szPath_*)

Delete_Folder Remove a folder from disk.

Parameters

*szPath_*	Path of the folder to remove

Returns

Index of the node deleted or INVALID_NODE on error

Definition at line 662 of file nlfs.cpp.

13.51.2.8 K_BOOL NLFS::File_Names_Match (const K_CHAR * *szPath_*, NLFS_Node_t * *pstNode_*) [protected]

File_Names_Match Determines if a given path matches the name in a file node.

Parameters

in	*szPath_*	- file path to search for
in	*pstNode_*	- pointer to a fs node

Returns

true if the filename in the path matches the filename in the node.

Definition at line 42 of file nlfs.cpp.

13.51.2.9 K_USHORT NLFS::Find_File (const K_CHAR * *szPath_*)

Find_File returns the file node ID of the object at a given path.

Parameters

in	*szPath_*	- Path of the file to search for

Returns

file node ID, or INVALID_NODE if the path is invalid.

Definition at line 405 of file nlfs.cpp.

13.51.2.10 K_CHAR NLFS::Find_Last_Slash (const K_CHAR * *szPath_*) [protected]

Find_Last_Slash Finds the location of the last '/' character in a path.

Parameters

in	*szPath_*	- String representing a '/' delimited path.

Returns

the byte offset of the last slash char in the path.

Definition at line 26 of file nlfs.cpp.

13.51.2.11 K_USHORT NLFS::Find_Parent_Dir (const K_CHAR * *szPath_*)

Find_Parent_Dir returns the directory under which the specified file object lives.

Parameters

in	*szPath_*	- Path of the file to find parent directory node for

Returns

directory node ID, or INVALID_NODE if the path is invalid.

Definition at line 289 of file nlfs.cpp.

13.51.2.12 void NLFS::Format (NLFS_Host_t * *puHost_*, K_ULONG *ulTotalSize_*, K_USHORT *usNumFiles_*, K_USHORT *usDataBlockSize_*)

Format/Create a new filesystem with the configuration specified in the parameters.

Parameters

in	*puHost_*	- Pointer to the FS storage object, interpreted by the physical medium driver.
in	*ulTotalSize_*	- Total size of the object to format (in bytes)
in	*usNumFiles_*	- Number of file nodes to create in the FS. This parameter determines the maximum number of files and directories that can exist simultaneously in the filesystem. All filesystem storage not allocated towards file nodes is automatically used as data-blocks.
	*usDataBlockSize_*	- Size of each data block (in bytes). Setting a lower block size is a good way to avoid wasting space in small-files due to over-allocation of storage (size on-disk vs. actual file size). However, each block requires a metadata object, which can also add to overhead. Also, file read/write speed can vary significantly based on the block size - in many scenarios, larger blocks can lead to higher throughput.

Definition at line 756 of file nlfs.cpp.

13.51.2.13 K_ULONG NLFS::GetBlockSize (void) [inline]

GetBlockSize retrieves the data block size for the filesystem.

Returns

The size of a data block in the filesystem, as configured at format.

Definition at line 382 of file nlfs.h.

13.51.2.14 K_USHORT NLFS::GetFirstChild (K_USHORT *usNode_*)

GetFirstChild Return the first child node for a node representing a directory.

Parameters

*usNode_*	Index of a directory node

Returns

Node ID of the first child node or INVALID_NODE on failure

Definition at line 890 of file nlfs.cpp.

13.51.2.15 K_USHORT NLFS::GetNextPeer (K_USHORT *usNode_*)

GetNextPeer Return the Node ID of a File/Directory's next peer.

Parameters

*usNode_*	Node index of the current object

Returns

Node ID of the next peer object

Definition at line 908 of file nlfs.cpp.

13.51.2.16 K_ULONG NLFS::GetNumBlocks (void) [inline]

GetNumBlocks retrieves the number of data blocks in the filesystem.

Returns

The total number of blocks in the filesystem

Definition at line 388 of file nlfs.h.

13.51.2.17 K_ULONG NLFS::GetNumBlocksFree (void) [inline]

GetNumBlocksFree retrieves the number of free data blocks in the filesystem.

Returns

The number of available blocks in the filesystem

Definition at line 395 of file nlfs.h.

13.51.2.18 K_ULONG NLFS::GetNumFiles (void) [inline]

GetNumFiles retrieves the maximum number of files in the filesystem.

Returns

The maximum number of files that can be allocated in the system

Definition at line 401 of file nlfs.h.

13.51.2.19 K_USHORT NLFS::GetNumFilesFree (void) [inline]

GetNumFilesFree retrieves the number of free blocks in the filesystem.

Returns

The number of free file nodes in the filesystem

Definition at line 407 of file nlfs.h.

13.51.2.20 K_BOOL NLFS::GetStat (K_USHORT *usNode_*, NLFS_File_Stat_t * *pstStat_*)

GetStat Get the status of a file on-disk.

Parameters

*usNode_*	Node representing the file
*pstStat_*	Pointer to the object containing the status

Returns

true on success, false on failure

Definition at line 920 of file nlfs.cpp.

13.51.2.21 void NLFS::Mount (NLFS_Host_t * *puHost_*)

Re-mount a previously-cerated filesystem using this FS object.

Parameters

in	*puHost_*	- Pointer to the filesystem object

! Must set the host pointer first.

Definition at line 859 of file nlfs.cpp.

13.51.2.22 K_ULONG NLFS::Pop_Free_Block (void) [protected]

Pop_Free_Block pops a file data block from the head of the free list.

Returns

the block index of the file node popped from the head of the free block list

Definition at line 192 of file nlfs.cpp.

13.51.2.23 K_USHORT NLFS::Pop_Free_Node (void) [protected]

Pop_Free_Node returns the first free file node in the free list.

Returns

the index of the file node popped off the free list

Definition at line 145 of file nlfs.cpp.

13.51.2.24 void NLFS::Print_Dir_Details (K_USHORT *usNode_*) [protected]

Print_Dir_Details displays information about a given directory node.

Parameters

in	*usNode_*	- directory index to display details for

Definition at line 90 of file nlfs.cpp.

13.51.2.25 void NLFS::Print_File_Details (K_USHORT *usNode_*) [protected]

Print_File_Details displays information about a given file node.

Parameters

in	*usNode_*	- file index to display details for

Definition at line 68 of file nlfs.cpp.

13.51.2.26 void NLFS::Print_Free_Details (K_USHORT *usNode_*) [protected]

Print_Free_Details Print details about a free node.

Parameters

*usNode_*	Node to print details for

Definition at line 106 of file nlfs.cpp.

13.51.2.27 void NLFS::Print_Node_Details (K_USHORT *usNode_*) [protected]

Print_Node_Details prints details about a node, the details differ based on whether it's a file/directory/root node.

Parameters

in	*usNode_*	- node to show details for

Definition at line 115 of file nlfs.cpp.

13.51.2.28 void NLFS::Push_Free_Block (K_ULONG *ulBlock_*) [protected]

Push_Free_Block returns a file block back to the head of the free block list.

Parameters

in	*ulBlock_*	- index of the data block to free

Definition at line 224 of file nlfs.cpp.

13.51.2.29 void NLFS::Push_Free_Node (K_USHORT *usNode_*) [protected]

Push_Free_Node returns a file node back to the free node list.

Parameters

in	*usNode_*	- index of the file node to push back to the free list.

Definition at line 172 of file nlfs.cpp.

13.51.2.30 virtual void NLFS::Read_Block (K_ULONG *ulBlock_*, K_ULONG *ulOffset_*, void * *pvData_*, K_ULONG *ulLen_*) [protected], [pure virtual]

Read_Block is an implementation-specific method used to read raw file data from physical storage into a local buffer.

Parameters

in	*ulBlock_*	- filesystem block ID corresponding to the file
in	*ulOffset_*	- offset (in bytes) from the beginning of the block
out	*pvData_*	- output buffer to read into
in	*ulLen_*	- length of data to read (in bytes)

Implemented in NLFS_RAM.

13.51.2.31 virtual void NLFS::Read_Block_Header (K_ULONG *ulBlock_*, NLFS_Block_t * *pstBlock_*) [protected], [pure virtual]

Read_Block_Header is an implementation-specific method used to read a file block header from physical storage into a local struct.

Parameters

in	*ulBlock_*	- data block index
out	*pstBlock_*	- block header structure to read into

Implemented in NLFS_RAM.

13.51.2.32 virtual void NLFS::Read_Node (K_USHORT *usNode_*, NLFS_Node_t * *pstNode_*) [protected], [pure virtual]

Read_Node is an implementation-specific method used to read a file node from physical storage into a local data struture.

Parameters

in	*usNode_*	- File node index
out	*pstNode_*	- Pointer to the file node object to read into

Implemented in NLFS_RAM.

13.51.2.33 void NLFS::RootSync ( ) [protected]

RootSync Synchronize the filesystem config in the object back to the underlying storage mechanism.

This needs to be called to ensure that underlying storage is kept consistent when creating or deleting files.

Definition at line 879 of file nlfs.cpp.

13.51.2.34 void NLFS::Set_Node_Name (NLFS_Node_t * *pstFileNode_*, const K_CHAR * *szPath_*) [protected]

Set_Node_Name sets the name of a file or directory node.

Parameters

in	*pstFileNode_*	- Pointer to a file node structure to name
in	*szPath_*	- Name for the file

Definition at line 458 of file nlfs.cpp.

13.51.2.35 virtual void NLFS::Write_Block (K_ULONG *ulBlock_*, K_ULONG *ulOffset_*, void * *pvData_*, K_ULONG *ulLen_*) [protected], [pure virtual]

Write_Block is an implementation-specific method used to write a piece of file data to its data block in the underlying physical storage.

Parameters

in	*ulBlock_*	- filesystem block ID corresponding to the file
in	*ulOffset_*	- offset (in bytes) from the beginning of the block
in	*pvData_*	- data buffer to write to disk
in	*ulLen_*	- length of data to write (in bytes)

Implemented in NLFS_RAM.

13.51.2.36 virtual void NLFS::Write_Block_Header (K_ULONG *ulBlock_*, NLFS_Block_t * *pstFileBlock_*) [protected], [pure virtual]

Write_Block_Header is an implementation-specific method used to write a file block header back to physical storage from a local struct.

Parameters

in	*ulBlock_*	- data block index
in	*pstFileBlock_*	- pointer to the local data structure to write from

Implemented in NLFS_RAM.

13.51.2.37 virtual void NLFS::Write_Node (K_USHORT *usNode_*, NLFS_Node_t * *pstNode_*) [protected], [pure virtual]

Write_Node is an implementation-specific method used to write a file node from a local structure back to the physical storage.

Parameters

in	*usNode_*	- File node index
in	*pstNode_*	- Pointer to the file node object to write from

Implemented in NLFS_RAM.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/nlfs.h
- /home/moslevin2/mark3/embedded/stage/src/nlfs.cpp

13.52 NLFS_Block_t Struct Reference

Block data structure.

`#include <nlfs.h>`

Public Attributes

- K_ULONG ulNextBlock

Index of the next block.

- union {
  K_UCHAR ucFlags
  Block Flags.
  struct {
  unsigned int uAllocated
  1 if allocated
  unsigned int uCheckBit
  Used for continuity checks.
  }
  };

13.52.1 Detailed Description

Block data structure.

Contains the block index of the next data block (either in the file, or in the free-data pool), as well as any special flags.

Definition at line 232 of file nlfs.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/nlfs.h

13.53 NLFS_File Class Reference

The NLFS_File class.

`#include <nlfs_file.h>`

Public Member Functions

- int Open (NLFS *pclFS_, const K_CHAR *szPath_, NLFS_File_Mode_t eMode_)
  Open Opens a file from a given filesystem.
- int Read (void *pvBuf_, K_ULONG ulLen_)
  Read Read bytes from a file into a specified data buffer.
- int Write (void *pvBuf_, K_ULONG ulLen_)
  Write Write a specified blob of data to the file.
- int Seek (K_ULONG ulOffset_)
  Seek Seek to the specified byte offset within the file.
- int Close (void)
  Close Is used to close an open file buffer.

Private Attributes

- NLFS * m_pclFileSystem
  Pointer to the host filesystem.
- K_ULONG m_ulOffset
  Current byte offset within the file.
- K_ULONG m_ulCurrentBlock
  Index of the current filesystem block.
- K_USHORT m_usFile

File index of the current file.

- NLFS_File_Mode_t m_ucFlags

  File mode flags.

- NLFS_Node_t m_stNode

  Local copy of the file node.

13.53.1 Detailed Description

The NLFS_File class.

This class contains an implementation of file-level access built on-top of the NLFS filesystem architecture. An instance of this class represents an active/open file from inside the NLFSfilesystem.

Definition at line 45 of file nlfs_file.h.

13.53.2 Member Function Documentation

13.53.2.1 int NLFS_File::Close (void)

Close Is used to close an open file buffer.

Returns

0 on success, -1 on failure.

Definition at line 272 of file nlfs_file.cpp.

13.53.2.2 int NLFS_File::Open (NLFS * *pclFS_*, const K_CHAR * *szPath_*, NLFS_File_Mode_t *eMode_*)

Open Opens a file from a given filesystem.

Parameters

*pclFS_*	- Pointer to the NLFS filesystem containing the file
*szPath_*	- Path to the file within the NLFS filesystem
*eMode_*	- File open mode

Returns

0 on success, -1 on failure

Definition at line 26 of file nlfs_file.cpp.

13.53.2.3 int NLFS_File::Read (void * *pvBuf_*, K_ULONG *ulLen_*)

Read Read bytes from a file into a specified data buffer.

Parameters

in	*ulLen_*	- Length (in bytes) of data to read
out	*pvBuf_*	- Pointer to the buffer to read into

Returns

Number of bytes read from the file

Definition at line 151 of file nlfs_file.cpp.

13.53.2.4 int NLFS_File::Seek (K_ULONG *ulOffset_*)

Seek Seek to the specified byte offset within the file.

Parameters

in	*ulOffset_*	Offset in bytes from the beginning of the file

Returns

0 on success, -1 on failure

Definition at line 112 of file nlfs_file.cpp.

13.53.2.5 int NLFS_File::Write (void * *pvBuf_*, K_ULONG *ulLen_*)

Write Write a specified blob of data to the file.

Parameters

in	*ulLen_*	- Length (in bytes) of the source buffer
in	*pvBuf_*	- Pointer to the data buffer containing the data to be written

Returns

Number of bytes written to the file

Definition at line 217 of file nlfs_file.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/nlfs_file.h
- /home/moslevin2/mark3/embedded/stage/src/nlfs_file.cpp

13.54 NLFS_File_Node_t Struct Reference

Data structure for the "file" FS-node type.

`#include <nlfs.h>`

Public Attributes

- K_CHAR acFileName [16]

  Arbitrary, 16-char filename.
- K_USHORT usNextPeer

  Index of the next peer file node.
- K_USHORT usPrevPeer

  Index of the previous peer node.

- K_UCHAR ucGroup

  Group ID of the owner.
- K_UCHAR ucUser

  User ID of the owner.
- K_USHORT usPerms

  File permissions (POSIX-style)
- K_USHORT usParent

  Index of the parent file node.
- K_USHORT usChild

  Index of the first child node.
- K_ULONG ulAllocSize

  Size of the file (allocated)
- K_ULONG ulFileSize

  Size of the file (in-bytes)
- K_ULONG ulFirstBlock

  Index of the first file block.
- K_ULONG ulLastBlock

  Index of the last file block.

13.54.1 Detailed Description

Data structure for the "file" FS-node type.

Note that this is the same as for a directory node (although fewer fields are used for that case, as documented).

Definition at line 168 of file nlfs.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/nlfs.h

13.55 NLFS_File_Stat_t Struct Reference

Structure used to report the status of a given file.

`#include <nlfs.h>`

Public Attributes

- K_ULONG ulAllocSize

  Size of the file including partial blocks.
- K_ULONG ulFileSize

  Actual size of the file.
- K_USHORT usPerms

  Permissions attached to the file.
- K_UCHAR ucUser

  User associated with this file.
- K_UCHAR ucGroup

  Group associated with this file.
- K_CHAR acFileName [16]

  Copy of the file name.

13.55.1 Detailed Description

Structure used to report the status of a given file.

Definition at line 266 of file nlfs.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/nlfs.h

13.56 NLFS_Host_t Union Reference

Union used for managing host-specific pointers/data-types.

`#include <nlfs.h>`

Public Attributes

- void * **pvData**
- uint32_t **u32Data**
- uint64_t **u64Data**
- K_ADDR **kaData**

13.56.1 Detailed Description

Union used for managing host-specific pointers/data-types.

This is all pretty abstract, as the data represented here is only accessed by the underlying physical media drive.

Definition at line 253 of file nlfs.h.

The documentation for this union was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/nlfs.h

13.57 NLFS_Node_t Struct Reference

Filesystem node data structure.

`#include <nlfs.h>`

Public Attributes

- NLFS_Type_t eBlockType

  Block type ID.
- union {
  NLFS_Root_Node_t stRootNode
  Root Filesystem Node.
  NLFS_File_Node_t stFileNode
  File/Directory Node.
  };

13.57.1 Detailed Description

Filesystem node data structure.

Contains the block type, as well as the union between the various FS-node data structures. This is also the same data format as how data is stored "on-disk"

Definition at line 215 of file nlfs.h.

The documentation for this struct was generated from the following file:

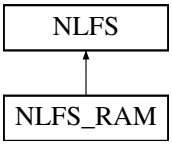
- /home/moslevin2/mark3/embedded/stage/src/nlfs.h

13.58 NLFS_RAM Class Reference

The NLFS_RAM class.

`#include <nlfs_ram.h>`

Inheritance diagram for NLFS_RAM:



Private Member Functions

- virtual void Read_Node (K_USHORT usNode_, NLFS_Node_t *pstNode_)

  Read_Node is an implementation-specific method used to read a file node from physical storage into a local data struture.
- virtual void Write_Node (K_USHORT usNode_, NLFS_Node_t *pstNode_)

  Write_Node is an implementation-specific method used to write a file node from a local structure back to the physical storage.
- virtual void Read_Block_Header (K_ULONG ulBlock_, NLFS_Block_t *pstBlock_)

  Read_Block_Header is an implementation-specific method used to read a file block header from physical storage into a local struct.
- virtual void Write_Block_Header (K_ULONG ulBlock_, NLFS_Block_t *pstFileBlock_)

  Write_Block_Header is an implementation-specific method used to write a file block header back to physical storage from a local struct.
- virtual void Read_Block (K_ULONG ulBlock_, K_ULONG ulOffset_, void *pvData_, K_ULONG ulLen_)

  Read_Block is an implementation-specific method used to read raw file data from physical storage into a local buffer.
- void Write_Block (K_ULONG ulBlock_, K_ULONG ulOffset_, void *pvData_, K_ULONG ulLen_)

  Write_Block is an implementation-specific method used to write a piece of file data to its data block in the underlying physical storage.

Additional Inherited Members

13.58.1 Detailed Description

The NLFS_RAM class.

This class implements an NLFS filesystem in a RAM buffer. In this case, the host pointer passed into the "format" call is a pointer to the locally- allocated buffer in which the filesystem lives.

Definition at line 31 of file nlfs_ram.h.

13.58.2 Member Function Documentation

13.58.2.1 void NLFS_RAM::Read_Block (K_ULONG *ulBlock_*, K_ULONG *ulOffset_*, void * *pvData_*, K_ULONG *ulLen_*) [private], [virtual]

Read_Block is an implementation-specific method used to read raw file data from physical storage into a local buffer.

Parameters

in	*ulBlock_*	- filesystem block ID corresponding to the file
in	*ulOffset_*	- offset (in bytes) from the beginning of the block
out	*pvData_*	- output buffer to read into
in	*ulLen_*	- length of data to read (in bytes)

Implements NLFS.

Definition at line 63 of file nlfs_ram.cpp.

13.58.2.2 void NLFS_RAM::Read_Block_Header (K_ULONG *ulBlock_*, NLFS_Block_t * *pstBlock_*) [private], [virtual]

Read_Block_Header is an implementation-specific method used to read a file block header from physical storage into a local struct.

Parameters

in	*ulBlock_*	- data block index
out	*pstBlock_*	- block header structure to read into

Implements NLFS.

Definition at line 43 of file nlfs_ram.cpp.

13.58.2.3 void NLFS_RAM::Read_Node (K_USHORT *usNode_*, NLFS_Node_t * *pstNode_*) [private], [virtual]

Read_Node is an implementation-specific method used to read a file node from physical storage into a local data struture.

Parameters

in	*usNode_*	- File node index
out	*pstNode_*	- Pointer to the file node object to read into

Implements NLFS.

Definition at line 25 of file nlfs_ram.cpp.

13.58.2.4 void NLFS_RAM::Write_Block (K_ULONG *ulBlock_*, K_ULONG *ulOffset_*, void * *pvData_*, K_ULONG *ulLen_*) [private], [virtual]

Write_Block is an implementation-specific method used to write a piece of file data to its data block in the underlying physical storage.

Parameters

in	*ulBlock_*	- filesystem block ID corresponding to the file
in	*ulOffset_*	- offset (in bytes) from the beginning of the block
in	*pvData_*	- data buffer to write to disk
in	*ulLen_*	- length of data to write (in bytes)

Implements NLFS.

Definition at line 73 of file nlfs_ram.cpp.

13.58.2.5 void NLFS_RAM::Write_Block_Header (K_ULONG *ulBlock_*, NLFS_Block_t * *pstFileBlock_*) [private], [virtual]

Write_Block_Header is an implementation-specific method used to write a file block header back to physical storage from a local struct.

Parameters

in	*ulBlock_*	- data block index
in	*pstFileBlock_*	- pointer to the local data structure to write from

Implements NLFS.

Definition at line 53 of file nlfs_ram.cpp.

13.58.2.6 void NLFS_RAM::Write_Node (K_USHORT *usNode_*, NLFS_Node_t * *pstNode_*) [private], [virtual]

Write_Node is an implementation-specific method used to write a file node from a local structure back to the physical storage.

Parameters

in	*usNode_*	- File node index
in	*pstNode_*	- Pointer to the file node object to write from

Implements NLFS.

Definition at line 34 of file nlfs_ram.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/nlfs_ram.h
- /home/moslevin2/mark3/embedded/stage/src/nlfs_ram.cpp

13.59 NLFS_Root_Node_t Struct Reference

Data structure for the Root-configuration FS-node type.

`#include <nlfs.h>`

Public Attributes

- K_USHORT usNumFiles

  Number of file nodes in the FS.
- K_USHORT usNumFilesFree

  Number of free file nodes.
- K_USHORT usNextFreeNode

  Index of the next free file.
- K_ULONG ulNumBlocks

  Number of blocks in the FS.
- K_ULONG ulNumBlocksFree

  Number of free blocks.

- K_ULONG ulNextFreeBlock

  Index of the next free block.
- K_ULONG ulBlockSize

  Size of each block on disk.
- K_ULONG ulBlockOffset

  Byte-offset to the first block struct.
- K_ULONG ulDataOffset

  Byte-offset to the first data block.

13.59.1 Detailed Description

Data structure for the Root-configuration FS-node type.

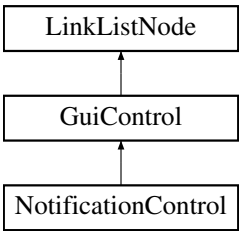
Definition at line 194 of file nlfs.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/nlfs.h

13.60 NotificationControl Class Reference

Inheritance diagram for NotificationControl:



Public Member Functions

- virtual void Init ()

  Initiailize the control - must be called before use.
- virtual void Draw ()

  Redraw the control "cleanly".
- virtual GuiReturn_t ProcessEvent (GuiEvent_t *pstEvent_)

  Process an event sent to the control.
- virtual void Activate (bool bActivate_)

  Activate or deactivate the current control - used when switching from one active control to another.
- void **SetFont** (Font_t *pstFont_)
- void **SetCaption** (const K_CHAR *szCaption_)
- void **Trigger** (K_USHORT usTimeout_)

Private Attributes

- const K_CHAR * **m_szCaption**
- Font_t * **m_pstFont**
- K_USHORT **m_usTimeout**
- bool **m_bTrigger**
- bool **m_bVisible**

Additional Inherited Members

13.60.1 Detailed Description

Definition at line 29 of file control_notification.h.

13.60.2 Member Function Documentation

13.60.2.1 virtual void NotificationControl::Activate (bool *bActivate_*) [inline], [virtual]

Activate or deactivate the current control - used when switching from one active control to another.

Parameters

*bActivate_*	- true to activate, false to deactivate

Implements GuiControl.

Definition at line 43 of file control_notification.h.

13.60.2.2 void NotificationControl::Draw ( ) [virtual]

Redraw the control "cleanly".

Subclass specific.

Implements GuiControl.

Definition at line 26 of file control_notification.cpp.

13.60.2.3 virtual void NotificationControl::Init ( ) [inline], [virtual]

Initiailize the control - must be called before use.

Implementation is subclass specific.

Implements GuiControl.

Definition at line 32 of file control_notification.h.

13.60.2.4 GuiReturn_t NotificationControl::ProcessEvent (GuiEvent_t * *pstEvent_*) [virtual]

Process an event sent to the control.

Subclass specific implementation.

Parameters

*pstEvent_*	Pointer to a struct containing the event data

Implements GuiControl.

Definition at line 92 of file control_notification.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/control_notification.h
- /home/moslevin2/mark3/embedded/stage/src/control_notification.cpp

13.61 Option_t Struct Reference

Structure used to represent a command-line option with its arguments.

`#include <shell_support.h>`

Public Attributes

- Token_t * pstStart

  Pointer to the beginning of a token array contain the option and its arguments.
- K_UCHAR ucCount

  Number of tokens in the token array.

13.61.1 Detailed Description

Structure used to represent a command-line option with its arguments.

An option is defined as any token beginning with a "-" value. The tokens arguments are subsequent tokens that do not begin with "-".

Where no "-" values are specified, each token becomes its own option.

i.e. given the following command-line

```
mycmd -opt1 a b c -opt2 d e f -opt 3
```

The possible Option_t structures would be:

```
pstStart => Array containing tokens for -opt1, a, b, c
ucCount  => 4 (4 tokens, including the option token, "-opt1")

pstStart => Array containing tokens for -opt2, d, e, f
ucCount  => 4 (4 tokens, including the option token, "-opt2")

pstStart => Array containing tokens for -opt, 3
ucCount  => 2 (2 tokens, including the option token, "-opt3")
```

in the case of:

```
mycmd a b c
```

Possible token values would be:

```
pstStart => Array containing tokens for a
ucCount  => 1

pstStart => Array containing tokens for b
ucCount  => 1

pstStart => Array containing tokens for c
ucCount  => 1
```

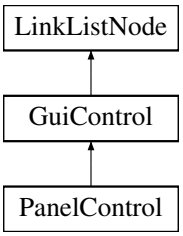
Definition at line 83 of file shell_support.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/shell_support.h

13.62 PanelControl Class Reference

Inheritance diagram for PanelControl:



Public Member Functions

- virtual void Init ()

  Initiailize the control - must be called before use.
- virtual void Draw ()

  Redraw the control "cleanly".
- virtual GuiReturn_t ProcessEvent (GuiEvent_t *pstEvent_)

  Process an event sent to the control.
- virtual void Activate (bool bActivate_)

  Activate or deactivate the current control - used when switching from one active control to another.
- void **SetColor** (COLOR eColor_)

Private Attributes

- COLOR **m_uColor**

Additional Inherited Members

13.62.1 Detailed Description

Definition at line 33 of file control_panel.h.

13.62.2 Member Function Documentation

13.62.2.1 virtual void PanelControl::Activate (bool *bActivate_*) [inline], [virtual]

Activate or deactivate the current control - used when switching from one active control to another.

Parameters

*bActivate_*	- true to activate, false to deactivate

Implements GuiControl.

Definition at line 39 of file control_panel.h.

13.62.2.2 void PanelControl::Draw ( ) [virtual]

Redraw the control "cleanly".

Subclass specific.

Implements GuiControl.

Definition at line 26 of file control_panel.cpp.

13.62.2.3 virtual void PanelControl::Init ( ) [inline], [virtual]

Initiailize the control - must be called before use.

Implementation is subclass specific.

Implements GuiControl.

Definition at line 36 of file control_panel.h.

13.62.2.4 virtual GuiReturn_t PanelControl::ProcessEvent (GuiEvent_t * *pstEvent_*) [inline], [virtual]

Process an event sent to the control.

Subclass specific implementation.

Parameters

*pstEvent_*	Pointer to a struct containing the event data

Implements GuiControl.

Definition at line 38 of file control_panel.h.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/control_panel.h
- /home/moslevin2/mark3/embedded/stage/src/control_panel.cpp

13.63 Profiler Class Reference

System profiling timer interface.

`#include <kprofile.h>`

Static Public Member Functions

- static void Init ()

  Initialize the global system profiler.
- static void Start ()

  Start the global profiling timer service.
- static void Stop ()

  Stop the global profiling timer service.
- static K_USHORT Read ()

  Read the current tick count in the timer.
- static void Process ()

  Process the profiling counters from ISR.
- static K_ULONG GetEpoch ()

  Return the current timer epoch.

Static Private Attributes

- static K_ULONG **m_ulEpoch**

13.63.1 Detailed Description

System profiling timer interface.

Definition at line 37 of file kprofile.h.

13.63.2 Member Function Documentation

13.63.2.1 void Profiler::Init (void) [static]

Initialize the global system profiler.

Must be called prior to use.

Definition at line 32 of file kprofile.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/kprofile.h
- /home/moslevin2/mark3/embedded/stage/src/kprofile.cpp

13.64 ProfileTimer Class Reference

Profiling timer.

`#include <profile.h>`

Public Member Functions

- void Init ()

  Initialize the profiling timer prior to use.
- void Start ()

  Start a profiling session, if the timer is not already active.
- void Stop ()

  Stop the current profiling session, adding to the cumulative time for this timer, and the total iteration count.
- K_ULONG GetAverage ()

  Get the average time associated with this operation.
- K_ULONG GetCurrent ()

  Return the current tick count held by the profiler.

Private Member Functions

- K_ULONG ComputeCurrentTicks (K_USHORT usCount_, K_ULONG ulEpoch_)

  Figure out how many ticks have elapsed in this iteration.

Private Attributes

- K_ULONG m_ulCumulative

  Cumulative tick-count for this timer.
- K_ULONG m_ulCurrentIteration

  Tick-count for the current iteration.
- K_USHORT m_usInitial

  Initial count.

- K_ULONG m_ulInitialEpoch

  Initial Epoch.
- K_USHORT m_usIterations

  Number of iterations executed for this profiling timer.
- K_UCHAR m_bActive

  Wheter or not the timer is active or stopped.

13.64.1 Detailed Description

Profiling timer.

This class is used to perform high-performance profiling of code to see how K_LONG certain operations take. Useful in instrumenting the performance of key algorithms and time-critical operations to ensure real-timer behavior.

Definition at line 69 of file profile.h.

13.64.2 Member Function Documentation

13.64.2.1 K_ULONG ProfileTimer::ComputeCurrentTicks (K_USHORT *usCount_*, K_ULONG *ulEpoch_*) [private]

Figure out how many ticks have elapsed in this iteration.

Parameters

*usCount_*	Current timer count
*ulEpoch_*	Current timer epoch

Returns

Current tick count

Definition at line 106 of file profile.cpp.

13.64.2.2 K_ULONG ProfileTimer::GetAverage ( )

Get the average time associated with this operation.

Returns

Average tick count normalized over all iterations

Definition at line 79 of file profile.cpp.

13.64.2.3 K_ULONG ProfileTimer::GetCurrent ( )

Return the current tick count held by the profiler.

Valid for both active and stopped timers.

Returns

The currently held tick count.

Definition at line 89 of file profile.cpp.

13.64.2.4 void ProfileTimer::Init (void)

Initialize the profiling timer prior to use.

Can also be used to reset a timer that's been used previously.

Definition at line 37 of file profile.cpp.

13.64.2.5 void ProfileTimer::Start (void)

Start a profiling session, if the timer is not already active.

Has no effect if the timer is already active.

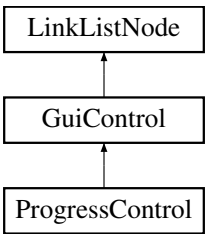
Definition at line 46 of file profile.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/profile.h
- /home/moslevin2/mark3/embedded/stage/src/profile.cpp

13.65 ProgressControl Class Reference

Inheritance diagram for ProgressControl:



Public Member Functions

- virtual void Init ()

  Initiailize the control - must be called before use.
- virtual void Draw ()

  Redraw the control "cleanly".
- virtual GuiReturn_t ProcessEvent (GuiEvent_t *pstEvent_)

  Process an event sent to the control.
- virtual void Activate (bool bActivate_)

  Activate or deactivate the current control - used when switching from one active control to another.
- void **SetBackColor** (COLOR eColor_)
- void **SetProgressColor** (COLOR eColor_)
- void **SetBorderColor** (COLOR eColor_)
- void **SetProgress** (K_UCHAR ucProgress_)

Private Attributes

- COLOR **m_uBackColor**
- COLOR **m_uProgressColor**
- COLOR **m_uBorderColor**
- K_UCHAR **m_ucProgress**

Additional Inherited Members

13.65.1 Detailed Description

Definition at line 30 of file control_progress.h.

13.65.2 Member Function Documentation

13.65.2.1 virtual void ProgressControl::Activate (bool *bActivate_*) [inline], [virtual]

Activate or deactivate the current control - used when switching from one active control to another.

Parameters

*bActivate_*	- true to activate, false to deactivate

Implements GuiControl.

Definition at line 36 of file control_progress.h.

13.65.2.2 void ProgressControl::Draw ( ) [virtual]

Redraw the control "cleanly".

Subclass specific.

Implements GuiControl.

Definition at line 36 of file control_progress.cpp.

13.65.2.3 void ProgressControl::Init ( ) [virtual]

Initiailize the control - must be called before use.

Implementation is subclass specific.

Implements GuiControl.

Definition at line 27 of file control_progress.cpp.

13.65.2.4 GuiReturn_t ProgressControl::ProcessEvent (GuiEvent_t * *pstEvent_*) [virtual]

Process an event sent to the control.

Subclass specific implementation.

Parameters

*pstEvent_*	Pointer to a struct containing the event data

Implements GuiControl.

Definition at line 102 of file control_progress.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/control_progress.h
- /home/moslevin2/mark3/embedded/stage/src/control_progress.cpp

13.66 Quantum Class Reference

Static-class used to implement Thread quantum functionality, which is a key part of round-robin scheduling.

`#include <quantum.h>`

Static Public Member Functions

- static void UpdateTimer ()

  This function is called to update the thread quantum timer whenever something in the scheduler has changed.
- static void AddThread (Thread *pclThread_)

  Add the thread to the quantum timer.
- static void RemoveThread ()

  Remove the thread from the quantum timer.

Static Private Member Functions

- static void SetTimer (Thread *pclThread_)

  Set up the quantum timer in the timer scheduler.

Static Private Attributes

- static Timer **m_clQuantumTimer**
- static K_UCHAR **m_bActive**

13.66.1 Detailed Description

Static-class used to implement Thread quantum functionality, which is a key part of round-robin scheduling.

Definition at line 39 of file quantum.h.

13.66.2 Member Function Documentation

13.66.2.1 void Quantum::AddThread (Thread * *pclThread_*) [static]

Add the thread to the quantum timer.

Only one thread can own the quantum, since only one thread can be running on a core at a time.

Definition at line 70 of file quantum.cpp.

13.66.2.2 void Quantum::RemoveThread (void) [static]

Remove the thread from the quantum timer.

This will cancel the timer.

Definition at line 87 of file quantum.cpp.

13.66.2.3 void Quantum::SetTimer (Thread * *pclThread_*) [static], [private]

Set up the quantum timer in the timer scheduler.

This creates a one-shot timer, which calls a static callback in quantum.cpp that on expiry will pivot the head of the threadlist for the thread's priority. This is the mechanism that provides round-robin scheduling in the system.

Parameters

*pclThread_*	Pointer to the thread to set the Quantum timer on

Definition at line 60 of file quantum.cpp.

13.66.2.4 void Quantum::UpdateTimer (void) [static]

This function is called to update the thread quantum timer whenever something in the scheduler has changed.

This can result in the timer being re-loaded or started. The timer is never stopped, but if may be ignored on expiry.

Definition at line 100 of file quantum.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/quantum.h
- /home/moslevin2/mark3/embedded/stage/src/quantum.cpp

13.67 Scheduler Class Reference

Priority-based round-robin Thread scheduling, using ThreadLists for housekeeping.

`#include <scheduler.h>`

Static Public Member Functions

- static void Init ()

  Intiailize the scheduler, must be called before use.
- static void Schedule ()

  Run the scheduler, determines the next thread to run based on the current state of the threads.
- static void Add (Thread *pclThread_)

  Add a thread to the scheduler at its current priority level.
- static void Remove (Thread *pclThread_)

  Remove a thread from the scheduler at its current priority level.
- static void SetScheduler (K_UCHAR bEnable_)

  Set the active state of the scheduler.
- static Thread * GetCurrentThread ()

  Return the pointer to the currently-running thread.
- static Thread * GetNextThread ()

  Return the pointer to the thread that should run next, according to the last run of the scheduler.
- static ThreadList * GetThreadList (K_UCHAR ucPriority_)

  Return the pointer to the active list of threads that are at the given priority level in the scheduler.
- static ThreadList * GetStopList ()

  Return the pointer to the list of threads that are in the scheduler's stopped state.
- static K_UCHAR IsEnabled ()

  Return the current state of the scheduler - whether or not scheudling is enabled or disabled.

Static Private Attributes

- static K_UCHAR m_bEnabled

  Scheduler's state - enabled or disabled.
- static ThreadList m_clStopList

ThreadList for all stopped threads.

- static ThreadList m_aclPriorities [NUM_PRIORITIES]

  ThreadLists for all threads at all priorities.

- static K_UCHAR m_ucPriFlag

  Bitmap flag for each.

13.67.1 Detailed Description

Priority-based round-robin Thread scheduling, using ThreadLists for housekeeping.

Definition at line 61 of file scheduler.h.

13.67.2 Member Function Documentation

13.67.2.1 void Scheduler::Add (Thread * *pclThread_*) [static]

Add a thread to the scheduler at its current priority level.

Parameters

*pclThread_*	Pointer to the thread to add to the scheduler

Definition at line 77 of file scheduler.cpp.

13.67.2.2 static Thread* Scheduler::GetCurrentThread ( ) [inline], [static]

Return the pointer to the currently-running thread.

Returns

Pointer to the currently-running thread

Definition at line 118 of file scheduler.h.

13.67.2.3 static Thread* Scheduler::GetNextThread ( ) [inline], [static]

Return the pointer to the thread that should run next, according to the last run of the scheduler.

Returns

Pointer to the next-running thread

Definition at line 126 of file scheduler.h.

13.67.2.4 static ThreadList* Scheduler::GetStopList ( ) [inline], [static]

Return the pointer to the list of threads that are in the scheduler's stopped state.

Returns

Pointer to the ThreadList containing the stopped threads

Definition at line 144 of file scheduler.h.

13.67.2.5 static ThreadList* Scheduler::GetThreadList (K_UCHAR *ucPriority_*) [inline], [static]

Return the pointer to the active list of threads that are at the given priority level in the scheduler.

Parameters

*ucPriority_*	Priority level of

Returns

Pointer to the ThreadList for the given priority level

Definition at line 136 of file scheduler.h.

13.67.2.6 K_UCHAR Scheduler::IsEnabled ( ) [inline], [static]

Return the current state of the scheduler - whether or not scheudling is enabled or disabled.

Returns

true - scheduler enabled, false - disabled

Definition at line 154 of file scheduler.h.

13.67.2.7 void Scheduler::Remove (Thread * *pclThread_*) [static]

Remove a thread from the scheduler at its current priority level.

Parameters

*pclThread_*	Pointer to the thread to be removed from the scheduler

Definition at line 84 of file scheduler.cpp.

13.67.2.8 Scheduler::Schedule ( ) [static]

Run the scheduler, determines the next thread to run based on the current state of the threads.

Note that the next-thread chosen from this function is only valid while in a critical section.

Definition at line 60 of file scheduler.cpp.

13.67.2.9 void Scheduler::SetScheduler (K_UCHAR *bEnable_*) [inline], [static]

Set the active state of the scheduler.

When the scheduler is disabled, the *next thread* is never set; the currently running thread will run forever until the scheduler is enabled again. Care must be taken to ensure that we don't end up trying to block while the scheduler is disabled, otherwise the system ends up in an unusable state.

Parameters

*bEnable_*	true to enable, false to disable the scheduler

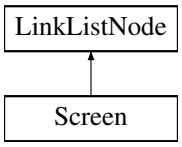
Definition at line 111 of file scheduler.h.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/scheduler.h
- /home/moslevin2/mark3/embedded/stage/src/scheduler.cpp

13.68 Screen Class Reference

Inheritance diagram for Screen:



Public Member Functions

- void Activate ()

  This is called when a new screen needs to be created.
- void Deactivate ()

  This is called when a screen is torn-down.
- void SetWindowAffinity (const K_CHAR *szWindowName_)

  Indicate by name which window this screen is to be bound.
- void SetName (const K_CHAR *szName_)

  Set the name of the current screen.
- const K_CHAR * GetName ()

  Return the name of the current screen.

Protected Member Functions

- void SetManager (ScreenManager *pclScreenManager_)

  Function called by the ScreenManager to set the screen affinity.

Protected Attributes

- const K_CHAR * **m_szName**
- ScreenManager * **m_pclScreenManager**
- GuiWindow * **m_pclWindow**

Private Member Functions

- virtual void **Create** ()=0
- virtual void **Destroy** ()=0

Friends

- class **ScreenManager**

13.68.1 Detailed Description

Definition at line 31 of file screen.h.

13.68.2 Member Function Documentation

13.68.2.1 void Screen::Activate ( ) [inline]

This is called when a new screen needs to be created.

This calls the underlying virtual "create" method, which performs all control object initialization and allocation. Calling a redraw(true) on the bound window will result in the new window being rendered to display.

Definition at line 40 of file screen.h.

13.68.2.2 void Screen::Deactivate ( ) [inline]

This is called when a screen is torn-down.

Essentially removes the controls from the named window and deallocates any memory used to build up the screen.

Definition at line 47 of file screen.h.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/screen.h
- /home/moslevin2/mark3/embedded/stage/src/screen.cpp

13.69 ScreenList Class Reference

Public Member Functions

- void Add (Screen *pclScreen_)

  Add a screen to the screen list.
- void Remove (Screen *pclScreen_)

  Remove a screen from the screen list.
- Screen * GetHead ()

  Get the beginning of the screen list.

Private Attributes

- DoubleLinkList m_clList

  Double link-list used to manage screen objects.

13.69.1 Detailed Description

Definition at line 84 of file screen.h.

The documentation for this class was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/screen.h

13.70 ScreenManager Class Reference

Public Member Functions

- void AddScreen (Screen *pclScreen_)

  Add a new screen to the screen manager.

- void RemoveScreen (Screen *pclScreen_)

  Remove an existing screen from the screen manager.
- void SetEventSurface (GuiEventSurface *pclSurface_)

  Set the event surface on which this screen manager's screens will be displayed.
- GuiWindow * FindWindowByName (const K_CHAR *m_szName_)

  Return a pointer to a window by name.
- Screen * FindScreenByName (const K_CHAR *m_szName_)

  Return a pointer to a screen by name.

Private Attributes

- ScreenList m_clScreenList

  Screen list object used to manage individual screens.
- GuiEventSurface * m_pclSurface

  Pointer to the GUI Event Surface on which the screens are displayed.

13.70.1 Detailed Description

Definition at line 109 of file screen.h.

The documentation for this class was generated from the following files:

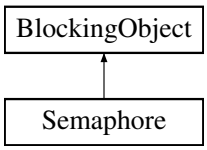
- /home/moslevin2/mark3/embedded/stage/src/screen.h
- /home/moslevin2/mark3/embedded/stage/src/screen.cpp

13.71 Semaphore Class Reference

Counting semaphore, based on BlockingObject base class.

`#include <ksemaphore.h>`

Inheritance diagram for Semaphore:



Public Member Functions

- void Init (K_USHORT usInitVal_, K_USHORT usMaxVal_)

  Initialize a semaphore before use.
- bool Post ()

  Increment the semaphore count.
- void Pend ()

  Decrement the semaphore count.
- K_USHORT GetCount ()

  Return the current semaphore counter.
- bool Pend (K_ULONG ulWaitTimeMS_)

  Decrement the semaphore count.

- void WakeMe (Thread *pclChosenOne_)

  Wake a thread blocked on the semaphore.
- void SetExpired (bool bExpired_)

  Set the semaphore expired flag on this object.
- bool **GetExpired** ()

Private Member Functions

- K_UCHAR WakeNext ()

  Wake the next thread waiting on the semaphore.

Private Attributes

- K_USHORT **m_usValue**
- K_USHORT **m_usMaxValue**
- bool **m_bExpired**

Additional Inherited Members

13.71.1 Detailed Description

Counting semaphore, based on BlockingObject base class.

Definition at line 37 of file ksemaphore.h.

13.71.2 Member Function Documentation

13.71.2.1 K_USHORT Semaphore::GetCount ( )

Return the current semaphore counter.

This can be used by a thread to bypass blocking on a semaphore - allowing it to do other things until a non-zero count is returned, instead of blocking until the semaphore is posted.

Returns

The current semaphore counter value.

Definition at line 227 of file ksemaphore.cpp.

13.71.2.2 void Semaphore::Init (K_USHORT *usInitVal_*, K_USHORT *usMaxVal_*)

Initialize a semaphore before use.

Must be called before post/pend operations.

Parameters

*usInitVal_*	Initial value held by the semaphore
*usMaxVal_*	Maximum value for the semaphore

Definition at line 84 of file ksemaphore.cpp.

13.71.2.3 void Semaphore::Pend ( )

Decrement the semaphore count.

If the count is zero, the thread will block until the semaphore is pended.

Definition at line 156 of file ksemaphore.cpp.

13.71.2.4 bool Semaphore::Pend (K_ULONG *ulWaitTimeMS_*)

Decrement the semaphore count.

If the count is zero, the thread will block until the semaphore is pended. If the specified interval expires before the thread is unblocked, then the status is returned back to the user.

Returns

true - semaphore was acquired before the timeout false - timeout occurred before the semaphore was claimed.

Definition at line 161 of file ksemaphore.cpp.

13.71.2.5 void Semaphore::Post ( )

Increment the semaphore count.

Returns

true if the semaphore was posted, false if the count is already maxed out.

Definition at line 98 of file ksemaphore.cpp.

13.71.2.6 void Semaphore::SetExpired (bool *bExpired_*) [inline]

```
Set the semaphore expired flag on this object.

\
```

Definition at line 115 of file ksemaphore.h.

13.71.2.7 void Semaphore::WakeMe (Thread * *pclChosenOne_*)

Wake a thread blocked on the semaphore.

This is an internal function used for implementing timed semaphores relying on timer callbacks. Since these do not have access to the private data of the semaphore and its base classes, we have to wrap this as a public method - do not use this for any other purposes.

Definition at line 57 of file ksemaphore.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/ksemaphore.h
- /home/moslevin2/mark3/embedded/stage/src/ksemaphore.cpp

13.72 ShellCommand_t Struct Reference

Data structure defining a lookup table correlating a command name to its handler function.

```
#include <shell_support.h>
```

Public Attributes

- const K_CHAR * szCommand

  Command name.
- fp_internal_command pfHandler

  Command handler function.

13.72.1 Detailed Description

Data structure defining a lookup table correlating a command name to its handler function.

Definition at line 117 of file shell_support.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/shell_support.h

13.73 ShellSupport Class Reference

The ShellSupport class features utility functions which handle token processing, option/parameter lookup, and functions making it generally trivial to implement a lightweight custom shell.

```
#include <shell_support.h>
```

Static Public Member Functions

- static K_CHAR RunCommand (CommandLine_t *pstCommand_, const ShellCommand_t *pastShellCommands_)

  RunCommand Given a command-line, attempts to run the corresponding shell command based where it exists within the supplied ShellCommand_t array.
- static void UnescapeToken (Token_t *pstToken_, K_CHAR *szDest_)

  UnescapeToken Convert a token which has special parsing characters in it to a "flattened" string, where all unescaped double quotes and escaped tab, newline, space, etc.
- static Option_t * CheckForOption (CommandLine_t *pstCommand_, const K_CHAR *szOption_)

  CheckForOption Check to see whether or not a specific option has been set within the commandline arguments.
- static K_CHAR TokensToCommandLine (Token_t *pastTokens_, K_UCHAR ucTokens_, CommandLine_t *pstCommand_)

  TokensToCommandLine Convert an array of tokens to a commandline object.

13.73.1 Detailed Description

The ShellSupport class features utility functions which handle token processing, option/parameter lookup, and functions making it generally trivial to implement a lightweight custom shell.

Definition at line 129 of file shell_support.h.

13.73.2 Member Function Documentation

13.73.2.1 Option_t * ShellSupport::CheckForOption (CommandLine_t * *pstCommand_*, const K_CHAR * *szOption_*) [static]

CheckForOption Check to see whether or not a specific option has been set within the commandline arguments.

Parameters

*pstCommand_*	Pointer to the commandline object containing the options
*szOption_*	0-terminated string corresponding to the command-line option.

Returns

Pointer to the command line option on match, or 0 on faiulre.

Definition at line 104 of file shell_support.cpp.

13.73.2.2 K_CHAR ShellSupport::RunCommand (CommandLine_t * *pstCommand_*, const ShellCommand_t * *pastShellCommands_*) [static]

RunCommand Given a command-line, attempts to run the corresponding shell command based where it exists within the supplied ShellCommand_t array.

Parameters

*pstCommand_*	Pointer to the command-line to execute
*pstCommands_*	Pointer to an array of shell commands to execute against

Returns

1 on success, 0 on error (command not found)

Definition at line 28 of file shell_support.cpp.

13.73.2.3 K_CHAR ShellSupport::TokensToCommandLine (Token_t * *pastTokens_*, K_UCHAR *ucTokens_*, CommandLine_t * *pstCommand_*) [static]

TokensToCommandLine Convert an array of tokens to a commandline object.

```
This operation is non-destructive to the source token
array.
```

Parameters

*pastTokens_*	Pointer to the token array to process
*ucTokens_*	Number of tokens in the token array
*pstCommand_*	Pointer to the CommandLine_t object which will represent the shell command and its arguments.

Returns

Number of options processed

Definition at line 123 of file shell_support.cpp.

13.73.2.4 void ShellSupport::UnescapeToken (Token_t * *pstToken_*, K_CHAR * *szDest_*) [static]

UnescapeToken Convert a token which has special parsing characters in it to a "flattened" string, where all unescaped double quotes and escaped tab, newline, space, etc.

characters are converted into their ascii-code equivalents.

Parameters

*pstToken_*	Pointer to the source token to convert
*szDest_*	Pointer to a destination string which will contain the parsed result string

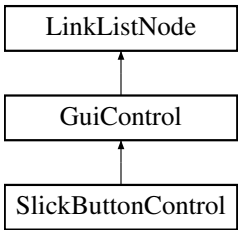
Definition at line 49 of file shell_support.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/shell_support.h
- /home/moslevin2/mark3/embedded/stage/src/shell_support.cpp

13.74 SlickButtonControl Class Reference

Inheritance diagram for SlickButtonControl:



Public Member Functions

- virtual void Init ()

  Initiailize the control - must be called before use.
- virtual void Draw ()

  Redraw the control "cleanly".
- virtual GuiReturn_t ProcessEvent (GuiEvent_t *pstEvent_)

  Process an event sent to the control.
- virtual void Activate (bool bActivate_)

  Activate or deactivate the current control - used when switching from one active control to another.
- void **SetFont** (Font_t *pstFont_)
- void **SetCaption** (const K_CHAR *szCaption_)
- void **SetCallback** (ButtonCallback pfCallback_, void *pvData_)

Private Attributes

- const K_CHAR * **m_szCaption**
- Font_t * **m_pstFont**
- bool **m_bState**
- K_UCHAR **m_ucTimeout**
- void * **m_pvCallbackData**
- ButtonCallback **m_pfCallback**

Additional Inherited Members

13.74.1 Detailed Description

Definition at line 32 of file control_slickbutton.h.

13.74.2 Member Function Documentation

13.74.2.1 void SlickButtonControl::Activate (bool *bActivate_*) [virtual]

Activate or deactivate the current control - used when switching from one active control to another.

Parameters

*bActivate_*	- true to activate, false to deactivate

Implements GuiControl.

Definition at line 286 of file control_slickbutton.cpp.

13.74.2.2 void SlickButtonControl::Draw ( ) [virtual]

Redraw the control "cleanly".

Subclass specific.

Implements GuiControl.

Definition at line 51 of file control_slickbutton.cpp.

13.74.2.3 void SlickButtonControl::Init ( ) [virtual]

Initiailize the control - must be called before use.

Implementation is subclass specific.

Implements GuiControl.

Definition at line 40 of file control_slickbutton.cpp.

13.74.2.4 GuiReturn_t SlickButtonControl::ProcessEvent (GuiEvent_t * *pstEvent_*) [virtual]

Process an event sent to the control.

Subclass specific implementation.

Parameters

*pstEvent_*	Pointer to a struct containing the event data

Implements GuiControl.

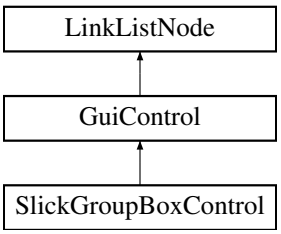
Definition at line 164 of file control_slickbutton.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/control_slickbutton.h
- /home/moslevin2/mark3/embedded/stage/src/control_slickbutton.cpp

13.75 SlickGroupBoxControl Class Reference

Inheritance diagram for SlickGroupBoxControl:



Public Member Functions

- virtual void Init ()

  Initiailize the control - must be called before use.
- virtual void Draw ()

  Redraw the control "cleanly".
- virtual GuiReturn_t ProcessEvent (GuiEvent_t *pstEvent_)

  Process an event sent to the control.
- virtual void Activate (bool bActivate_)

  Activate or deactivate the current control - used when switching from one active control to another.
- void **SetFont** (Font_t *pstFont_)
- void **SetCaption** (const K_CHAR *pcCaption_)
- void **SetBGColor** (COLOR uColor_)

Private Attributes

- Font_t * **m_pstFont**
- const K_CHAR * **m_pcCaption**
- COLOR **m_uBGColor**

Additional Inherited Members

13.75.1 Detailed Description

Definition at line 29 of file control_slickgroupbox.h.

13.75.2 Member Function Documentation

13.75.2.1 virtual void SlickGroupBoxControl::Activate (bool *bActivate_*) [inline], [virtual]

Activate or deactivate the current control - used when switching from one active control to another.

Parameters

*bActivate_*	- true to activate, false to deactivate

Implements GuiControl.

Definition at line 35 of file control_slickgroupbox.h.

13.75.2.2 void SlickGroupBoxControl::Draw ( ) [virtual]

Redraw the control "cleanly".

Subclass specific.

Implements GuiControl.

Definition at line 31 of file control_slickgroupbox.cpp.

13.75.2.3 virtual void SlickGroupBoxControl::Init ( ) [inline], [virtual]

Initiailize the control - must be called before use.

Implementation is subclass specific.

Implements GuiControl.

Definition at line 32 of file control_slickgroupbox.h.

13.75.2.4 virtual GuiReturn_t SlickGroupBoxControl::ProcessEvent (GuiEvent_t * *pstEvent_*) [inline], [virtual]

Process an event sent to the control.

Subclass specific implementation.

Parameters

*pstEvent_*	Pointer to a struct containing the event data

Implements GuiControl.

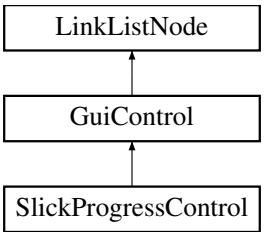
Definition at line 34 of file control_slickgroupbox.h.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/control_slickgroupbox.h
- /home/moslevin2/mark3/embedded/stage/src/control_slickgroupbox.cpp

13.76 SlickProgressControl Class Reference

Inheritance diagram for SlickProgressControl:



Public Member Functions

- virtual void Init ()

  Initiailize the control - must be called before use.
- virtual void Draw ()

  Redraw the control "cleanly".
- virtual GuiReturn_t ProcessEvent (GuiEvent_t *pstEvent_)

  Process an event sent to the control.

- virtual void Activate (bool bActivate_)

  Activate or deactivate the current control - used when switching from one active control to another.
- void **SetProgress** (K_UCHAR ucProgress_)

Private Attributes

- K_UCHAR **m_ucProgress**

Additional Inherited Members

13.76.1 Detailed Description

Definition at line 30 of file control_slickprogress.h.

13.76.2 Member Function Documentation

13.76.2.1 virtual void SlickProgressControl::Activate (bool *bActivate_*) [inline], [virtual]

Activate or deactivate the current control - used when switching from one active control to another.

Parameters

*bActivate_*	- true to activate, false to deactivate

Implements GuiControl.

Definition at line 36 of file control_slickprogress.h.

13.76.2.2 void SlickProgressControl::Draw ( ) [virtual]

Redraw the control "cleanly".

Subclass specific.

Implements GuiControl.

Definition at line 33 of file control_slickprogress.cpp.

13.76.2.3 void SlickProgressControl::Init ( ) [virtual]

Initiailize the control - must be called before use.

Implementation is subclass specific.

Implements GuiControl.

Definition at line 27 of file control_slickprogress.cpp.

13.76.2.4 GuiReturn_t SlickProgressControl::ProcessEvent (GuiEvent_t * *pstEvent_*) [virtual]

Process an event sent to the control.

Subclass specific implementation.

Parameters

*pstEvent_*	Pointer to a struct containing the event data

Implements GuiControl.

Definition at line 107 of file control_slickprogress.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/control_slickprogress.h
- /home/moslevin2/mark3/embedded/stage/src/control_slickprogress.cpp

13.77 Slip Class Reference

Object used to frame communications over an abstract device using the serial-line internet protocol (SLIP).

`#include <slip.h>`

Public Member Functions

- void SetDriver (Driver *pclDriver_)

  Set the driver to attach to this object.
- Driver * GetDriver ()

  Return the pointer to the driver attached to this object.
- void WriteData (K_UCHAR ucChannel_, const K_CHAR *aucBuf_, K_USHORT usLen_)

  Write a packet of data in the FunkenSlip format.
- K_USHORT ReadData (K_UCHAR *pucChannel_, K_CHAR *aucBuf_, K_USHORT usLen_)

  Read a packet from a specified device, parse, and copy to a specified output buffer.
- void WriteVector (K_UCHAR ucChannel_, SlipDataVector *astData_, K_USHORT usLen_)

  Write a single message composed of multiple data-vector fragments.
- void SendAck ()

  Send an acknowledgement character to the host.
- void SendNack ()

  Send a negative-acknowledgement character to the host.

Static Public Member Functions

- static K_USHORT EncodeByte (K_UCHAR ucChar_, K_UCHAR *aucBuf_)

  Encode a single byte into a stream, returning the size of the encoded value (either 1 or 2 bytes).
- static K_USHORT DecodeByte (K_UCHAR *ucChar_, const K_UCHAR *aucBuf_)

  Decode a byte from a stream into a specified value.

Private Member Functions

- void **WriteByte** (K_UCHAR ucData_)

Private Attributes

- Driver * **m_pclDriver**

13.77.1 Detailed Description

Object used to frame communications over an abstract device using the serial-line internet protocol (SLIP).

Definition at line 70 of file slip.h.

13.77.2 Member Function Documentation

13.77.2.1 K_USHORT Slip::DecodeByte (K_UCHAR * *ucChar_*, const K_UCHAR * *aucBuf_*) [static]

Decode a byte from a stream into a specified value.

Returns the number of bytes from the source array that were processed, (1 or 2), or 0 if an end-of-packet (192) was encountered.

Parameters

*ucChar_*	Destination K_CHAR
*aucBuf_*	Source buffer

Returns

bytes read, or 0 on terminating character (192)

Definition at line 56 of file slip.cpp.

13.77.2.2 K_USHORT Slip::EncodeByte (K_UCHAR *ucChar_*, K_UCHAR * *aucBuf_*) [static]

Encode a single byte into a stream, returning the size of the encoded value (either 1 or 2 bytes).

Parameters

*ucChar_*	Character to encode
*aucBuf_*	Buffer to encode into

Returns

bytes read

Definition at line 34 of file slip.cpp.

13.77.2.3 Driver* Slip::GetDriver ( ) [inline]

Return the pointer to the driver attached to this object.

Returns

Pointer to the driver attached

Definition at line 85 of file slip.h.

13.77.2.4 K_USHORT Slip::ReadData (K_UCHAR * *pucChannel_*, K_CHAR * *aucBuf_*, K_USHORT *usLen_*)

Read a packet from a specified device, parse, and copy to a specified output buffer.

Parameters

*pucChannel_*	Pointer to a uchar that stores the message channel
*aucBuf_*	Buffer where the message will be decoded
*usLen_*	Length of the buffer to decode

Returns

data bytes read, 0 on failure.

Definition at line 104 of file slip.cpp.

13.77.2.5 void Slip::SetDriver (Driver * *pclDriver_*) [inline]

Set the driver to attach to this object.

Parameters

*pclDriver_*	Pointer to the driver to attach

Definition at line 78 of file slip.h.

13.77.2.6 void Slip::WriteData (K_UCHAR *ucChannel_*, const K_CHAR * *aucBuf_*, K_USHORT *usLen_*)

Write a packet of data in the FunkenSlip format.

Returns the number of bytes from the source array that were processed, (1 or 2), or 0 if an end-of-packet (192) was encountered.

Parameters

*ucChannel_*	Channel to encode the packet to
*aucBuf_*	Payload to encode
*usLen_*	Length of payload data

Definition at line 164 of file slip.cpp.

13.77.2.7 void Slip::WriteVector (K_UCHAR *ucChannel_*, SlipDataVector * *astData_*, K_USHORT *usLen_*)

Write a single message composed of multiple data-vector fragments.

Allows for transmitting complex data structures without requiring buffering. This operation is zero-copy.

Parameters

*ucChannel_*	Message channel
*astData_*	Pointer to the data vector
*usLen_*	Number of elements in the data vector

Definition at line 223 of file slip.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/slip.h
- /home/moslevin2/mark3/embedded/stage/src/slip.cpp

13.78 SlipDataVector Struct Reference

Data structure used for vector-based SLIP data transmission.

`#include <slip.h>`

Public Attributes

- K_UCHAR ucSize

  Size of the data buffer.
- K_UCHAR * pucData

  Pointer to the data buffer.

13.78.1 Detailed Description

Data structure used for vector-based SLIP data transmission.

Allows for building and transmitting complex data structures without having to copy data into intermediate buffers.

Definition at line 59 of file slip.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/slip.h

13.79 SlipMux Class Reference

Static-class which implements a multiplexed stream of SLIP data over a single interface.

`#include <slip_mux.h>`

Static Public Member Functions

- static void Init (const K_CHAR *pcDriverPath_, K_USHORT usRxSize_, K_UCHAR *aucRx_, K_USHORT usTxSize_, K_UCHAR *aucTx_)

  Attach a driver to the Slip-stream multiplexer and initialize the internal data associated with the module.
- static void InstallHandler (K_UCHAR ucChannel_, Slip_Channel pfHandler_)

  Install a slip handler function for the given communication channel.
- static void MessageReceive ()

  Wait for a valid packet to arrive, and call the appropriate handler function for the channel the message was attached to.
- static Driver * GetDriver ()

  Return the pointer of the current driver used by the SlipMux module.
- static MessageQueue * GetQueue ()

  Return the pointer to the message queue attached to the slip mux channel.
- static void SetQueue (MessageQueue *pclMessageQueue_)

  Set the message queue that will receive the notification when the slip mux channel has received data.
- static Slip * GetSlip ()

  Return the pointer to the SlipMux' Slip object.

Static Private Attributes

- static MessageQueue * **m_pclMessageQueue**
- static Driver * **m_pclDriver**
- static Slip_Channel **m_apfChannelHandlers** [SLIP_CHANNEL_COUNT] = {0}
- static K_UCHAR **m_aucData** [SLIP_BUFFER_SIZE]
- static Semaphore **m_clSlipSem**
- static Slip **m_clSlip**

13.79.1 Detailed Description

Static-class which implements a multiplexed stream of SLIP data over a single interface.

Definition at line 43 of file slip_mux.h.

13.79.2 Member Function Documentation

13.79.2.1 static Driver* SlipMux::GetDriver ( ) [inline], [static]

Return the pointer of the current driver used by the SlipMux module.

Returns

Pointer to the current handle owned by SlipMux

Definition at line 91 of file slip_mux.h.

13.79.2.2 static MessageQueue* SlipMux::GetQueue ( ) [inline], [static]

Return the pointer to the message queue attached to the slip mux channel.

Returns

Pointer to the message Queue

Definition at line 99 of file slip_mux.h.

13.79.2.3 static Slip* SlipMux::GetSlip ( ) [inline], [static]

Return the pointer to the SlipMux' Slip object.

Returns

Pointer to the Slip object

Definition at line 117 of file slip_mux.h.

13.79.2.4 void SlipMux::Init (const K_CHAR * *pcDriverPath_*, K_USHORT *usRxSize_*, K_UCHAR * *aucRx_*, K_USHORT *usTxSize_*, K_UCHAR * *aucTx_*) [static]

Attach a driver to the Slip-stream multiplexer and initialize the internal data associated with the module.

Must be called before any of the other functions in this module are called.

Parameters

*pcDriverPath_*	Filesystem path to the driver to attach to
*usRxSize_*	Size of the RX Buffer to attach to the driver
*aucRx_*	Pointer to the RX Buffer to attach to the driver
*usTxSize_*	Size of the TX Buffer to attach to the driver
*aucTx_*	Pointer to the TX Buffer to attach to the driver

Definition at line 59 of file slip_mux.cpp.

13.79.2.5 void SlipMux::InstallHandler (K_UCHAR *ucChannel_*, Slip_Channel *pfHandler_*) [static]

Install a slip handler function for the given communication channel.

Parameters

*ucChannel_*	Channel to attach the handler to
*pfHandler_*	Pointer to the handler function to attach

Definition at line 76 of file slip_mux.cpp.

13.79.2.6 void SlipMux::MessageReceive (void) [static]

Wait for a valid packet to arrive, and call the appropriate handler function for the channel the message was attached to.

This is essentially the entry point for a thread whose purpose is to service slip Rx data.

Definition at line 85 of file slip_mux.cpp.

13.79.2.7 static void SlipMux::SetQueue (MessageQueue * *pclMessageQueue_*) [inline], [static]

Set the message queue that will receive the notification when the slip mux channel has received data.

Parameters

*pclMessage-Queue_*	Pointer to the message queue to use for notification.

Definition at line 108 of file slip_mux.h.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/slip_mux.h
- /home/moslevin2/mark3/embedded/stage/src/slip_mux.cpp

13.80 SlipTerm Class Reference

Class implementing a simple debug terminal interface.

`#include <slipterm.h>`

Public Member Functions

- void Init ()

  Initialize the terminal by opening a handle to the serial interface attached at /dev/tty.
- void PrintLn (const char *szLine_)

  Print a string of text to the SLIP interface, multiplexed using the FunkenSlip terminal channel.
- void PrintLn (K_UCHAR ucSeverity_, const char *szLine_)

  Print a string of text to the SLIP interface, but only if the current logging verbosity level is greater than or equal to the specified message severity.
- void SetVerbosity (K_UCHAR ucLevel_)

  Set the logging verbosity level - the minimum severity level that will be printed to the terminal.

Private Member Functions

- K_USHORT StrLen (const char *szString_)

  Quick 'n' dirty StrLen functionality used for printing the string.

Private Attributes

- K_UCHAR m_ucVerbosity
- Slip m_clSlip

  Slip object that this module interfaces with.

13.80.1 Detailed Description

Class implementing a simple debug terminal interface.

This is useful for printf style debugging.

Definition at line 40 of file slipterm.h.

13.80.2 Member Function Documentation

13.80.2.1 void SlipTerm::Init (void)

Initialize the terminal by opening a handle to the serial interface attached at /dev/tty.

Must be called prior to using the print functionality.

Definition at line 26 of file slipterm.cpp.

13.80.2.2 void SlipTerm::PrintLn (const char * *szLine_*)

Print a string of text to the SLIP interface, multiplexed using the FunkenSlip terminal channel.

Parameters

*szLine_*	String to print

Definition at line 44 of file slipterm.cpp.

13.80.2.3 void SlipTerm::PrintLn (K_UCHAR *ucSeverity_*, const char * *szLine_*)

Print a string of text to the SLIP interface, but only if the current logging verbosity level is greater than or equal to the specified message severity.

Parameters

*ucSeverity_*	Message severity level, 0 = highest severity
*szLine_*	String to print

Definition at line 56 of file slipterm.cpp.

13.80.2.4 void SlipTerm::SetVerbosity (K_UCHAR *ucLevel_*) [inline]

Set the logging verbosity level - the minimum severity level that will be printed to the terminal.

The higher the number, the more chatty the output.

Definition at line 81 of file slipterm.h.

13.80.2.5 K_USHORT SlipTerm::StrLen (const char * *szString_*) [private]

Quick 'n' dirty StrLen functionality used for printing the string.

Returns

Length of the string (in bytes)

Definition at line 33 of file slipterm.cpp.

13.80.3 Member Data Documentation

13.80.3.1 K_UCHAR SlipTerm::m_ucVerbosity [private]

```
Verbosity level.  Messages with a severity
```

level greater than this Are not displayed.

Definition at line 92 of file slipterm.h.

The documentation for this class was generated from the following files:

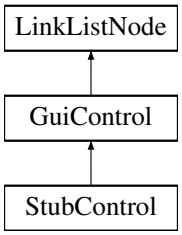
- /home/moslevin2/mark3/embedded/stage/src/slipterm.h
- /home/moslevin2/mark3/embedded/stage/src/slipterm.cpp

13.81 StubControl Class Reference

Stub control class, used for testing out the GUI framework where certain controls have not yet been implemented.

`#include <gui.h>`

Inheritance diagram for StubControl:



Public Member Functions

- virtual void Init ()

  Initiailize the control - must be called before use.
- virtual void Draw ()

  Redraw the control "cleanly".
- virtual GuiReturn_t ProcessEvent (GuiEvent_t *pstEvent_)

  Process an event sent to the control.
- virtual void Activate (bool bActivate_)

  Activate or deactivate the current control - used when switching from one active control to another.

Additional Inherited Members

13.81.1 Detailed Description

Stub control class, used for testing out the GUI framework where certain controls have not yet been implemented.

Definition at line 796 of file gui.h.

13.81.2 Member Function Documentation

13.81.2.1 virtual void StubControl::Activate (bool *bActivate_*) [inline], [virtual]

Activate or deactivate the current control - used when switching from one active control to another.

Parameters

*bActivate_*	- true to activate, false to deactivate

Implements GuiControl.

Definition at line 802 of file gui.h.

13.81.2.2 virtual void StubControl::Draw ( ) [inline], [virtual]

Redraw the control "cleanly".

Subclass specific.

Implements GuiControl.

Definition at line 800 of file gui.h.

13.81.2.3 virtual void StubControl::Init ( ) [inline], [virtual]

Initiailize the control - must be called before use.

Implementation is subclass specific.

Implements GuiControl.

Definition at line 799 of file gui.h.

13.81.2.4 virtual GuiReturn_t StubControl::ProcessEvent (GuiEvent_t * *pstEvent_*) [inline], [virtual]

Process an event sent to the control.

Subclass specific implementation.

Parameters

*pstEvent_*	Pointer to a struct containing the event data

Implements GuiControl.

Definition at line 801 of file gui.h.

The documentation for this class was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/gui.h

13.82 SystemHeap Class Reference

The SystemHeap class implements a heap which is accessible from all components in the system.

`#include <system_heap.h>`

Static Public Member Functions

- static void Init (void)

  Init Initialize the system heap prior to usage.
- static void * Alloc (K_USHORT usSize_)

  Alloc allocate a block of data from the heap.
- static void Free (void *pvData_)

  Free free a block of data previously allocated from the heap.

Static Private Attributes

- static K_UCHAR m_pucRawHeap [HEAP_RAW_SIZE]

  Raw heap buffer.
- static HeapConfig m_pclSystemHeapConfig [HEAP_NUM_SIZES+1]

  Heap configuration metadata.
- static FixedHeap m_clSystemHeap

  Heap management object.
- static bool m_bInit

  True if initialized, false if uninitialized.

13.82.1 Detailed Description

The SystemHeap class implements a heap which is accessible from all components in the system.

Definition at line 189 of file system_heap.h.

13.82.2 Member Function Documentation

13.82.2.1 void * SystemHeap::Alloc (K_USHORT *usSize_*) [static]

Alloc allocate a block of data from the heap.

Parameters

*usSize_*	size of the block (in bytes) to allocate

Returns

pointer to a block of data allocated from the heap, or NULL on failure.

Definition at line 130 of file system_heap.cpp.

13.82.2.2 void SystemHeap::Free (void * *pvData_*) [static]

Free free a block of data previously allocated from the heap.

Parameters

*pvData_*	Pointer to a block of data allocated from the system heap

Definition at line 140 of file system_heap.cpp.

The documentation for this class was generated from the following files:

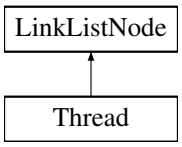
- /home/moslevin2/mark3/embedded/stage/src/system_heap.h
- /home/moslevin2/mark3/embedded/stage/src/system_heap.cpp

13.83 Thread Class Reference

Object providing fundamental multitasking support in the kernel.

`#include <thread.h>`

Inheritance diagram for Thread:



Public Member Functions

- void Init (K_UCHAR *paucStack_, K_USHORT usStackSize_, K_UCHAR ucPriority_, ThreadEntry_t pfEntryPoint_, void *pvArg_)

  Initialize a thread prior to its use.
- void Start ()

  Start the thread - remove it from the stopped list, add it to the scheduler's list of threads (at the thread's set priority), and continue along.
- void Stop ()

  Stop a thread that's actively scheduled without destroying its stacks.
- void SetName (const K_CHAR *szName_)

  Set the name of the thread - this is purely optional, but can be useful when identifying issues that come along when multiple threads are at play in a system.
- const K_CHAR * GetName ()
- ThreadList * GetOwner (void)

  Return the ThreadList where the thread belongs when it's in the active/ready state in the scheduler.
- ThreadList * GetCurrent (void)

  Return the ThreadList where the thread is currently located.
- K_UCHAR GetPriority (void)

  Return the priority of the current thread.
- K_UCHAR GetCurPriority (void)

  Return the priority of the current thread.
- void SetQuantum (K_USHORT usQuantum_)

  Set the thread's round-robin execution quantum.
- K_USHORT GetQuantum (void)

  Get the thread's round-robin execution quantum.
- void SetCurrent (ThreadList *pclNewList_)

  Set the thread's current to the specified thread list.
- void SetOwner (ThreadList *pclNewList_)

Set the thread's owner to the specified thread list.

- void SetPriority (K_UCHAR ucPriority_)

  Set the priority of the Thread (running or otherwise) to a different level.
- void InheritPriority (K_UCHAR ucPriority_)

  Allow the thread to run at a different priority level (temporarily) for the purpose of avoiding priority inversions.
- void Exit ()

  Remove the thread from being scheduled again.
- void SetID (K_UCHAR ucID_)

  Set an 8-bit ID to uniquely identify this thread.
- K_UCHAR GetID ()

  Return the 8-bit ID corresponding to this thread.
- K_USHORT GetStackSlack ()

  Performs a (somewhat lengthy) check on the thread stack to check the amount of stack margin (or "slack") remaining on the stack.

Static Public Member Functions

- static void Sleep (K_ULONG ulTimeMs_)

  Put the thread to sleep for the specified time (in milliseconds).
- static void USleep (K_ULONG ulTimeUs_)

  Put the thread to sleep for the specified time (in microseconds).
- static void Yield (void)

  Yield the thread - this forces the system to call the scheduler and determine what thread should run next.

Private Member Functions

- void SetPriorityBase (K_UCHAR ucPriority_)

Static Private Member Functions

- static void ContextSwitchSWI (void)

  This code is used to trigger the context switch interrupt.

Private Attributes

- K_UCHAR * m_paucStackTop

  Pointer to the top of the thread's stack.
- K_UCHAR * m_paucStack

  Pointer to the thread's stack.
- K_USHORT m_usStackSize

  Size of the stack (in bytes)
- K_USHORT m_usQuantum

  Thread quantum (in milliseconds)
- K_UCHAR m_ucThreadID

  Thread ID.
- K_UCHAR m_ucPriority

  Default priority of the thread.
- K_UCHAR m_ucCurPriority

  Current priority of the thread (priority inheritence)
- ThreadEntry_t m_pfEntryPoint

The entry-point function called when the thread starts.

- void * m_pvArg

  Pointer to the argument passed into the thread's entrypoint.

- const K_CHAR * m_szName

  Thread name.

- ThreadList * m_pclCurrent

  Pointer to the thread-list where the thread currently resides.

- ThreadList * m_pclOwner

  Pointer to the thread-list where the thread resides when active.

Friends

- class **ThreadPort**

Additional Inherited Members

13.83.1 Detailed Description

Object providing fundamental multitasking support in the kernel.

Definition at line 64 of file thread.h.

13.83.2 Member Function Documentation

13.83.2.1 void Thread::ContextSwitchSWI (void) [static], [private]

This code is used to trigger the context switch interrupt.

Called whenever the kernel decides that it is necessary to swap out the current thread for the "next" thread.

Definition at line 331 of file thread.cpp.

13.83.2.2 void Thread::Exit ( )

Remove the thread from being scheduled again.

The thread is effectively destroyed when this occurs. This is extremely useful for cases where a thread encounters an unrecoverable error and needs to be restarted, or in the context of systems where threads need to be created and destroyed dynamically.

This must not be called on the idle thread.

Definition at line 149 of file thread.cpp.

13.83.2.3 K_UCHAR Thread::GetCurPriority (void) [inline]

Return the priority of the current thread.

Returns

Priority of the current thread

Definition at line 167 of file thread.h.

13.83.2.4 ThreadList * Thread::GetCurrent (void) [inline]

Return the ThreadList where the thread is currently located.

Returns

Pointer to the thread's current list

Definition at line 148 of file thread.h.

13.83.2.5 K_UCHAR Thread::GetID ( ) [inline]

Return the 8-bit ID corresponding to this thread.

Returns

Thread's 8-bit ID, set by the user

Definition at line 295 of file thread.h.

13.83.2.6 const K_CHAR * Thread::GetName ( ) [inline]

Returns

Pointer to the name of the thread. If this is not set, will be NULL.

Definition at line 128 of file thread.h.

13.83.2.7 ThreadList * Thread::GetOwner (void) [inline]

Return the ThreadList where the thread belongs when it's in the active/ready state in the scheduler.

Returns

Pointer to the Thread's owner list

Definition at line 139 of file thread.h.

13.83.2.8 K_UCHAR Thread::GetPriority (void) [inline]

Return the priority of the current thread.

Returns

Priority of the current thread

Definition at line 158 of file thread.h.

13.83.2.9 K_USHORT Thread::GetQuantum (void) [inline]

Get the thread's round-robin execution quantum.

Returns

The thread's quantum

Definition at line 186 of file thread.h.

13.83.2.10 K_USHORT Thread::GetStackSlack ( )

Performs a (somewhat lengthy) check on the thread stack to check the amount of stack margin (or "slack") remaining on the stack.

If you're having problems with blowing your stack, you can run this function at points in your code during development to see what operations cause problems. Also useful during development as a tool to optimally size thread stacks.

Returns

The amount of slack (unused bytes) on the stack

! ToDo: Take into account stacks that grow up

Definition at line 232 of file thread.cpp.

13.83.2.11 void Thread::InheritPriority (K_UCHAR *ucPriority_*)

Allow the thread to run at a different priority level (temporarily) for the purpose of avoiding priority inversions.

This should only be called from within the implementation of blocking-objects.

Parameters

*ucPriority_*	New Priority to boost to.

Definition at line 324 of file thread.cpp.

13.83.2.12 void Thread::Init (K_UCHAR * *paucStack_*, K_USHORT *usStackSize_*, K_UCHAR *ucPriority_*, ThreadEntry_t *pfEntryPoint_*, void * *pvArg_*)

Initialize a thread prior to its use.

Initialized threads are placed in the stopped state, and are not scheduled until the thread's start method has been invoked first.

Parameters

*paucStack_*	Pointer to the stack to use for the thread
*usStackSize_*	Size of the stack (in bytes)
*ucPriority_*	Priority of the thread (0 = idle, 7 = max)
*pfEntryPoint_*	This is the function that gets called when the thread is started
*pvArg_*	Pointer to the argument passed into the thread's entrypoint function.

< Default round-robin thread quantum of 4ms

Definition at line 41 of file thread.cpp.

13.83.2.13 void Thread::SetCurrent (ThreadList * *pclNewList_*) [inline]

Set the thread's current to the specified thread list.

Parameters

*pclNewList_*	Pointer to the threadlist to apply thread ownership

Definition at line 196 of file thread.h.

13.83.2.14 void Thread::SetID (K_UCHAR *ucID_*) [inline]

Set an 8-bit ID to uniquely identify this thread.

Parameters

*ucID_*	8-bit Thread ID, set by the user

Definition at line 286 of file thread.h.

13.83.2.15 void Thread::SetName (const K_CHAR * *szName_*) [inline]

Set the name of the thread - this is purely optional, but can be useful when identifying issues that come along when multiple threads are at play in a system.

Parameters

*szName_*	Char string containing the thread name

Definition at line 120 of file thread.h.

13.83.2.16 void Thread::SetOwner (ThreadList * *pclNewList_*) [inline]

Set the thread's owner to the specified thread list.

Parameters

*pclNewList_*	Pointer to the threadlist to apply thread ownership

Definition at line 205 of file thread.h.

13.83.2.17 void Thread::SetPriority (K_UCHAR *ucPriority_*)

Set the priority of the Thread (running or otherwise) to a different level.

This activity involves re-scheduling, and must be done so with due caution, as it may effect the determinism of the system.

This should *always* be called from within a critical section to prevent system issues.

Parameters

*ucPriority_*	New priority of the thread

Definition at line 287 of file thread.cpp.

13.83.2.18 void Thread::SetPriorityBase (K_UCHAR *ucPriority_*) [private]

Parameters

*ucPriority_*	

Definition at line 277 of file thread.cpp.

13.83.2.19 void Thread::SetQuantum (K_USHORT *usQuantum_*) [inline]

Set the thread's round-robin execution quantum.

Parameters

*usQuantum_*	Thread's execution quantum (in milliseconds)

Definition at line 177 of file thread.h.

13.83.2.20 void Thread::Sleep (K_ULONG *ulTimeMs_*) [static]

Put the thread to sleep for the specified time (in milliseconds).

Actual time slept may be longer (but not less than) the interval specified.

Parameters

*ulTimeMs_*	Time to sleep (in ms)

Definition at line 188 of file thread.cpp.

13.83.2.21 void Thread::Stop (void)

Stop a thread that's actively scheduled without destroying its stacks.

Stopped threads can be restarted using the Start() API.

Definition at line 121 of file thread.cpp.

13.83.2.22 void Thread::USleep (K_ULONG *ulTimeUs_*) [static]

Put the thread to sleep for the specified time (in microseconds).

Actual time slept may be longer (but not less than) the interval specified.

Parameters

*ulTimeUs_*	Time to sleep (in microseconds)

Definition at line 210 of file thread.cpp.

13.83.2.23 void Thread::Yield (void) [static]

Yield the thread - this forces the system to call the scheduler and determine what thread should run next.

This is typically used when threads are moved in and out of the scheduler.

Definition at line 253 of file thread.cpp.

The documentation for this class was generated from the following files:

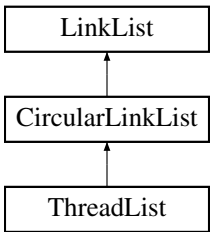
- /home/moslevin2/mark3/embedded/stage/src/thread.h
- /home/moslevin2/mark3/embedded/stage/src/thread.cpp

13.84 ThreadList Class Reference

This class is used for building thread-management facilities, such as schedulers, and blocking objects.

`#include <threadlist.h>`

Inheritance diagram for ThreadList:



Public Member Functions

- ThreadList ()

  Default constructor - zero-initializes the data.
- void SetPriority (K_UCHAR ucPriority_)

  Set the priority of this threadlist (if used for a scheduler).
- void SetFlagPointer (K_UCHAR *pucFlag_)

  Set the pointer to a bitmap to use for this threadlist.
- void Add (LinkListNode *node_)

  Add a thread to the threadlist.
- void Add (LinkListNode *node_, K_UCHAR *pucFlag_, K_UCHAR ucPriority_)

  Add a thread to the threadlist, specifying the flag and priority at the same time.
- void Remove (LinkListNode *node_)

  Remove the specified thread from the threadlist.
- Thread * HighestWaiter ()

  Return a pointer to the highest-priority thread in the thread-list.

Private Attributes

- K_UCHAR m_ucPriority

  Priority of the threadlist.
- K_UCHAR * m_pucFlag

  Pointer to the bitmap/flag to set when used for scheduling.

Additional Inherited Members

13.84.1 Detailed Description

This class is used for building thread-management facilities, such as schedulers, and blocking objects.

Definition at line 34 of file threadlist.h.

13.84.2 Member Function Documentation

13.84.2.1 void ThreadList::Add (LinkListNode * *node_*) [virtual]

Add a thread to the threadlist.

Parameters

*node_*	Pointer to the thread (link list node) to add to the list

Reimplemented from CircularLinkList.

Definition at line 46 of file threadlist.cpp.

13.84.2.2 void ThreadList::Add (LinkListNode * *node_*, K_UCHAR * *pucFlag_*, K_UCHAR *ucPriority_*)

Add a thread to the threadlist, specifying the flag and priority at the same time.

Parameters

*node_*	Pointer to the thread to add (link list node)
*pucFlag_*	Pointer to the bitmap flag to set (if used in a scheduler context), or NULL for non-scheduler.
*ucPriority_*	Priority of the threadlist

Definition at line 62 of file threadlist.cpp.

13.84.2.3 Thread * ThreadList::HighestWaiter ( )

Return a pointer to the highest-priority thread in the thread-list.

Returns

Pointer to the highest-priority thread

Definition at line 87 of file threadlist.cpp.

13.84.2.4 void ThreadList::Remove (LinkListNode * *node_*) [virtual]

Remove the specified thread from the threadlist.

Parameters

*node_*	Pointer to the thread to remove

Reimplemented from CircularLinkList.

Definition at line 71 of file threadlist.cpp.

13.84.2.5 void ThreadList::SetFlagPointer (K_UCHAR * *pucFlag_*)

Set the pointer to a bitmap to use for this threadlist.

Once again, only needed when the threadlist is being used for scheduling purposes.

Parameters

*pucFlag_*	Pointer to the bitmap flag

Definition at line 40 of file threadlist.cpp.

13.84.2.6 void ThreadList::SetPriority (K_UCHAR *ucPriority_*)

Set the priority of this threadlist (if used for a scheduler).

Parameters

*ucPriority_*	Priority level of the thread list

Definition at line 34 of file threadlist.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/threadlist.h
- /home/moslevin2/mark3/embedded/stage/src/threadlist.cpp

13.85 ThreadPort Class Reference

Class defining the architecture specific functions required by the kernel.

`#include <threadport.h>`

Static Public Member Functions

- static void StartThreads ()

  Function to start the scheduler, initial threads, etc.

Static Private Member Functions

- static void InitStack (Thread *pstThread_)

  Initialize the thread's stack.

Friends

- class **Thread**

13.85.1 Detailed Description

Class defining the architecture specific functions required by the kernel.

This is limited (at this point) to a function to start the scheduler, and a function to initialize the default stack-frame for a thread.

Definition at line 167 of file threadport.h.

13.85.2 Member Function Documentation

13.85.2.1 void ThreadPort::InitStack (Thread * *pstThread_*) [static], [private]

Initialize the thread's stack.

Parameters

*pstThread_*	Pointer to the thread to initialize

Definition at line 37 of file threadport.cpp.

The documentation for this class was generated from the following files:

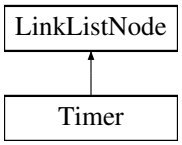
- /home/moslevin2/mark3/embedded/stage/src/threadport.h
- /home/moslevin2/mark3/embedded/stage/src/threadport.cpp

13.86 Timer Class Reference

Timer - an event-driven execution context based on a specified time interval.

`#include <timerlist.h>`

Inheritance diagram for Timer:



Public Member Functions

- Timer ()

  Default Constructor - zero-initializes all internal data.
- void Start (K_UCHAR bRepeat_, K_ULONG ulIntervalMs_, TimerCallback_t pfCallback_, void *pvData_)

  Start a timer using default ownership, using repeats as an option, and millisecond resolution.
- void Stop ()

  Stop a timer already in progress.
- void SetFlags (K_UCHAR ucFlags_)

  Set the timer's flags based on the bits in the ucFlags_ argument.
- void SetCallback (TimerCallback_t pfCallback_)

  Define the callback function to be executed on expiry of the timer.
- void SetData (void *pvData_)

  Define a pointer to be sent to the timer callbcak on timer expiry.
- void SetOwner (Thread *pclOwner_)

  Set the owner-thread of this timer object (all timers must be owned by a thread).
- void SetIntervalTicks (K_ULONG ulTicks_)

  Set the timer expiry in system-ticks (platform specific!)
- void SetIntervalSeconds (K_ULONG ulSeconds_)

  ! The next three cost us 330 bytes of flash on AVR...
- void SetIntervalMSeconds (K_ULONG ulMSeconds_)

  Set the timer expiry interval in milliseconds (platform agnostic)
- void SetIntervalUSeconds (K_ULONG ulUSeconds_)

  Set the timer expiry interval in microseconds (platform agnostic)

Private Attributes

- K_UCHAR m_ucFlags

  Flags for the timer, defining if the timer is one-shot or repeated.
- TimerCallback_t m_pfCallback

  Pointer to the callback function.
- K_ULONG m_ulInterval

  Interval of the timer in timer ticks.
- K_ULONG m_ulTimeLeft

  Time remaining on the timer.
- Thread * m_pclOwner

  Pointer to the owner thread.
- void * m_pvData

  Pointer to the callback data.

Friends

- class **TimerList**

Additional Inherited Members

13.86.1 Detailed Description

Timer - an event-driven execution context based on a specified time interval.

This inherits from a LinkListNode for ease of management by a global TimerList object.

Definition at line 78 of file timerlist.h.

13.86.2 Member Function Documentation

13.86.2.1 void Timer::SetCallback (TimerCallback_t *pfCallback_*) [inline]

Define the callback function to be executed on expiry of the timer.

Parameters

*pfCallback_*	Pointer to the callback function to call

Definition at line 116 of file timerlist.h.

13.86.2.2 void Timer::SetData (void * *pvData_*) [inline]

Define a pointer to be sent to the timer callbcak on timer expiry.

Parameters

*pvData_*	Pointer to data to pass as argument into the callback

Definition at line 125 of file timerlist.h.

13.86.2.3 void Timer::SetFlags (K_UCHAR *ucFlags_*) [inline]

Set the timer's flags based on the bits in the ucFlags_ argument.

Parameters

*ucFlags_*	Flags to assign to the timer object. TIMERLIST_FLAG_ONE_SHOT for a one-shot timer, 0 for a continuous timer.

Definition at line 107 of file timerlist.h.

13.86.2.4 void Timer::SetIntervalMSeconds (K_ULONG *ulMSeconds_*)

Set the timer expiry interval in milliseconds (platform agnostic)

Parameters

*ulMSeconds_*	Time in milliseconds

Definition at line 273 of file timerlist.cpp.

13.86.2.5 void Timer::SetIntervalSeconds (K_ULONG *ulSeconds_*)

! The next three cost us 330 bytes of flash on AVR...

Set the timer expiry interval in seconds (platform agnostic)

Parameters

*ulSeconds_*	Time in seconds

Definition at line 267 of file timerlist.cpp.

13.86.2.6 void Timer::SetIntervalTicks (K_ULONG *ulTicks_*)

Set the timer expiry in system-ticks (platform specific!)

Parameters

*ulTicks_*	Time in ticks

Definition at line 259 of file timerlist.cpp.

13.86.2.7 void Timer::SetIntervalUSeconds (K_ULONG *ulUSeconds_*)

Set the timer expiry interval in microseconds (platform agnostic)

Parameters

*ulUSeconds_*	Time in microseconds

Definition at line 279 of file timerlist.cpp.

13.86.2.8 void Timer::SetOwner (**Thread** * *pclOwner_*) [inline]

Set the owner-thread of this timer object (all timers must be owned by a thread).

Parameters

*pclOwner_*	Owner thread of this timer object

Definition at line 135 of file timerlist.h.

13.86.2.9 void Timer::Stop (void)

Stop a timer already in progress.

Has no effect on timers that have already been stopped.

Definition at line 253 of file timerlist.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/timerlist.h
- /home/moslevin2/mark3/embedded/stage/src/timerlist.cpp

13.87 TimerEvent_t Struct Reference

Timer UI event structure.

`#include <gui.h>`

Public Attributes

- K_USHORT usTicks
  Number of clock ticks (arbitrary) that have elapsed.

13.87.1 Detailed Description

Timer UI event structure.

Definition at line 177 of file gui.h.

The documentation for this struct was generated from the following file:

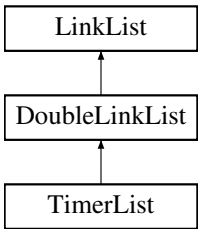
- /home/moslevin2/mark3/embedded/stage/src/gui.h

13.88 TimerList Class Reference

TimerList class - a doubly-linked-list of timer objects.

`#include <timerlist.h>`

Inheritance diagram for TimerList:



Public Member Functions

- void Init ()
  Initialize the TimerList object.
- void Add (Timer *pclListNode_)
  Add a timer to the TimerList.
- void Remove (Timer *pclListNode_)
  Remove a timer from the TimerList, cancelling its expiry.
- void Process ()
  Process all timers in the timerlist as a result of the timer expiring.

Private Attributes

- K_ULONG m_ulNextWakeup
  The time (in system clock ticks) of the next wakeup event.
- K_UCHAR m_bTimerActive
  Whether or not the timer is active.

Additional Inherited Members

13.88.1 Detailed Description

TimerList class - a doubly-linked-list of timer objects.

Definition at line 200 of file timerlist.h.

13.88.2 Member Function Documentation

13.88.2.1 void TimerList::Add (Timer * *pclListNode_*)

Add a timer to the TimerList.

Parameters

*pclListNode_*	Pointer to the Timer to Add

Definition at line 58 of file timerlist.cpp.

13.88.2.2 void TimerList::Init (void)

Initialize the TimerList object.

Must be called before using the object.

Definition at line 51 of file timerlist.cpp.

13.88.2.3 void TimerList::Process (void)

Process all timers in the timerlist as a result of the timer expiring.

This will select a new timer epoch based on the next timer to expire. ToDo - figure out if we need to deal with any overtime here.

Definition at line 113 of file timerlist.cpp.

13.88.2.4 void TimerList::Remove (Timer * *pclListNode_*)

Remove a timer from the TimerList, cancelling its expiry.

Parameters

*pclListNode_*	Pointer to the Timer to remove

Definition at line 98 of file timerlist.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/timerlist.h
- /home/moslevin2/mark3/embedded/stage/src/timerlist.cpp

13.89 TimerScheduler Class Reference

"Static" Class used to interface a global TimerList with the rest of the kernel.

`#include <timerlist.h>`

Static Public Member Functions

- static void Init ()

  Initialize the timer scheduler.
- static void Add (Timer *pclListNode_)

  Add a timer to the timer scheduler.
- static void Remove (Timer *pclListNode_)

  Remove a timer from the timer scheduler.
- static void Process ()

  This function must be called on timer expiry (from the timer's ISR context).

Static Private Attributes

- static TimerList m_clTimerList

  TimerList object manipulated by the Timer Scheduler.

13.89.1 Detailed Description

"Static" Class used to interface a global TimerList with the rest of the kernel.

Definition at line 250 of file timerlist.h.

13.89.2 Member Function Documentation

13.89.2.1 void TimerScheduler::Add (Timer * *pclListNode_*) [inline], [static]

Add a timer to the timer scheduler.

Adding a timer implicitly starts the timer as well.

Parameters

*pclListNode_*	Pointer to the timer list node to add

Definition at line 269 of file timerlist.h.

13.89.2.2 void TimerScheduler::Init (void) [inline], [static]

Initialize the timer scheduler.

Must be called before any timer, or timer-derived functions are used.

Definition at line 259 of file timerlist.h.

13.89.2.3 void TimerScheduler::Process (void) [inline], [static]

This function must be called on timer expiry (from the timer's ISR context).

This will result in all timers being updated based on the epoch that just elapsed. New timer epochs are set based on the next timer to expire.

Definition at line 291 of file timerlist.h.

13.89.2.4 void TimerScheduler::Remove (Timer * *pclListNode_*) [inline],[static]

Remove a timer from the timer scheduler.

May implicitly stop the timer if this is the only active timer scheduled.

Parameters

*pclListNode_*	Pointer to the timer list node to remove

Definition at line 280 of file timerlist.h.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/timerlist.h
- /home/moslevin2/mark3/embedded/stage/src/timerlist.cpp

13.90 Token_t Struct Reference

Token descriptor struct format.

`#include <memutil.h>`

Public Attributes

- const K_CHAR * pcToken

  Pointer to the beginning of the token string.
- K_UCHAR ucLen

  Length of the token (in bytes)

13.90.1 Detailed Description

Token descriptor struct format.

Definition at line 32 of file memutil.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/memutil.h

13.91 TouchEvent_t Struct Reference

Touch UI event structure.

`#include <gui.h>`

Public Attributes

- K_USHORT usX

  Absolute touch location (pixels)
- K_USHORT usY

  Absolute touch location (pixels)

- union {
  K_USHORT ucFlags
  Modifier flags.
  struct {
  unsigned int bTouch:1
  Whether or not touch is up or down.
  }
  };

13.91.1 Detailed Description

Touch UI event structure.

Definition at line 125 of file gui.h.

The documentation for this struct was generated from the following file:

- /home/moslevin2/mark3/embedded/stage/src/gui.h

13.92 UnitTest Class Reference

Class used to implement a simple unit-testing framework.

`#include <unit_test.h>`

Public Member Functions

- void SetName (const K_CHAR *szName_)
  Set the name of the test object.
- void Start ()
  Start a new test iteration.
- void Pass ()
  Stop the current iteration (if started), and register that the test was successful.
- void Fail ()
  Stop the current iterations (if started), and register that the current test failed.
- void **ExpectTrue** (bool bExpression_)
- void **ExpectFalse** (bool bExpression_)
- void **ExpectEquals** (bool bVal_, bool bExpression_)
- void **ExpectEquals** (K_UCHAR ucVal_, K_UCHAR ucExpression_)
- void **ExpectEquals** (K_USHORT usVal_, K_USHORT usExpression_)
- void **ExpectEquals** (K_ULONG ulVal_, K_ULONG ulExpression_)
- void **ExpectEquals** (K_CHAR cVal_, K_CHAR cExpression_)
- void **ExpectEquals** (K_SHORT sVal_, K_SHORT sExpression_)
- void **ExpectEquals** (K_LONG lVal_, K_LONG lExpression_)
- void **ExpectEquals** (void *pvVal_, void *pvExpression_)
- void **ExpectFailTrue** (bool bExpression_)
- void **ExpectFailFalse** (bool bExpression_)
- void **ExpectFailEquals** (bool bVal_, bool bExpression_)
- void **ExpectFailEquals** (K_UCHAR ucVal_, K_UCHAR ucExpression_)
- void **ExpectFailEquals** (K_USHORT usVal_, K_USHORT usExpression_)
- void **ExpectFailEquals** (K_ULONG ulVal_, K_ULONG ulExpression_)
- void **ExpectFailEquals** (K_CHAR cVal_, K_CHAR cExpression_)
- void **ExpectFailEquals** (K_SHORT sVal_, K_SHORT sExpression_)

- void **ExpectFailEquals** (K_LONG lVal_, K_LONG lExpression_)
- void **ExpectFailEquals** (void *pvVal_, void *pvExpression_)
- void **ExpectGreaterThan** (K_LONG lVal_, K_LONG lExpression_)
- void **ExpectLessThan** (K_LONG lVal_, K_LONG lExpression_)
- void **ExpectGreaterThanEquals** (K_LONG lVal_, K_LONG lExpression_)
- void **ExpectLessThanEquals** (K_LONG lVal_, K_LONG lExpression_)
- void **ExpectFailGreaterThan** (K_LONG lVal_, K_LONG lExpression_)
- void **ExpectFailLessThan** (K_LONG lVal_, K_LONG lExpression_)
- void **ExpectFailGreaterThanEquals** (K_LONG lVal_, K_LONG lExpression_)
- void **ExpectFailLessThanEquals** (K_LONG lVal_, K_LONG lExpression_)
- void Complete ()

  Complete the test.
- const K_CHAR * GetName ()

  Get the name of the tests associated with this object.
- K_BOOL GetResult ()

  Return the result of the last test.
- K_USHORT GetPassed ()

  Return the total number of test points/iterations passed.
- K_USHORT GetFailed ()

  Return the number of failed test points/iterations.
- K_USHORT GetTotal ()

  Return the total number of iterations/test-points executed.

Private Attributes

- const K_CHAR * m_szName

  Name of the tests performed.
- K_BOOL m_bIsActive

  Whether or not the test is active.
- K_UCHAR m_bComplete

  Whether or not the test is complete.
- K_BOOL m_bStatus

  Status of the last-run test.
- K_USHORT m_usIterations

  Number of iterations executed.
- K_USHORT m_usPassed

  Number of iterations that have passed.

13.92.1 Detailed Description

Class used to implement a simple unit-testing framework.

Definition at line 28 of file unit_test.h.

13.92.2 Member Function Documentation

13.92.2.1 void UnitTest::Complete ( ) [inline]

Complete the test.

Once a test has been completed, no new iterations can be started (i.e Start()/Pass()/Fail() will have no effect).

Definition at line 157 of file unit_test.h.

13.92.2.2 K_USHORT UnitTest::GetFailed ( ) [inline]

Return the number of failed test points/iterations.

Returns

Failed test point/iteration count

Definition at line 193 of file unit_test.h.

13.92.2.3 const K_CHAR * UnitTest::GetName ( ) [inline]

Get the name of the tests associated with this object.

Returns

Name of the test

Definition at line 166 of file unit_test.h.

13.92.2.4 K_USHORT UnitTest::GetPassed ( ) [inline]

Return the total number of test points/iterations passed.

Returns

Count of all successful test points/iterations

Definition at line 184 of file unit_test.h.

13.92.2.5 K_BOOL UnitTest::GetResult ( ) [inline]

Return the result of the last test.

Returns

Status of the last run test (false = fail, true = pass)

Definition at line 175 of file unit_test.h.

13.92.2.6 K_USHORT UnitTest::GetTotal ( ) [inline]

Return the total number of iterations/test-points executed.

Returns

Total number of ierations/test-points executed

Definition at line 202 of file unit_test.h.

13.92.2.7 void UnitTest::SetName (const K_CHAR * *szName_*) [inline]

Set the name of the test object.

Parameters

*szName_*	Name of the tests associated with this object

Definition at line 41 of file unit_test.h.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/unit_test.h
- /home/moslevin2/mark3/embedded/stage/src/unit_test.cpp

13.93 WriteBuffer16 Class Reference

This class is used to provide a general-purpose, fully thread-safe circular buffer implementation which can be used for creating tracebuffers, data logging queues, transaction queues, etc.

`#include <writebuf16.h>`

Public Member Functions

- void SetBuffers (K_USHORT *pusData_, K_USHORT usSize_)

  Assign the data to be used as storage for this circular buffer.
- void SetCallback (WriteBufferCallback pfCallback_)

  Set the callback function to be called when the buffer hits 50% of its capacity, and again when the buffer rolls over completely.
- void WriteData (K_USHORT *pusBuf_, K_USHORT usLen_)

  Write an array of values to the circular buffer.
- void WriteVector (K_USHORT **ppusBuf_, K_USHORT *pusLen_, K_UCHAR ucCount_)

  Write a multi-part vector to the circular buffer.

Private Attributes

- K_USHORT * m_pusData

  Pointer to the circular buffer data.
- volatile K_USHORT m_usSize

  Size of the buffer.
- volatile K_USHORT m_usHead

  Current head element (where data is written)
- volatile K_USHORT m_usTail

  Current tail element (where data is read)
- WriteBufferCallback m_pfCallback

  Buffer callback function.

13.93.1 Detailed Description

This class is used to provide a general-purpose, fully thread-safe circular buffer implementation which can be used for creating tracebuffers, data logging queues, transaction queues, etc.

We use it for implementing a debug print journal.

Definition at line 37 of file writebuf16.h.

13.93.2 Member Function Documentation

13.93.2.1 void WriteBuffer16::SetBuffers (K_USHORT * *pusData_*, K_USHORT *usSize_*) [inline]

Assign the data to be used as storage for this circular buffer.

Parameters

*pusData_*	Pointer to the array of data to be managed as a circular buffer by this object.
*usSize_*	Size of the buffer in 16-bit elements

Definition at line 50 of file writebuf16.h.

13.93.2.2 void WriteBuffer16::SetCallback (WriteBufferCallback *pfCallback_*) [inline]

Set the callback function to be called when the buffer hits 50% of its capacity, and again when the buffer rolls over completely.

Parameters

*pfCallback_*	Function pointer to call whenever the buffer has reached 50% capacity, or has rolled over completely.

Definition at line 69 of file writebuf16.h.

13.93.2.3 void WriteBuffer16::WriteData (K_USHORT * *pusBuf_*, K_USHORT *usLen_*)

Write an array of values to the circular buffer.

Parameters

*pusBuf_*	Source data array to write to the circular buffer
*usLen_*	Length of the source data array in 16-bit elements

Definition at line 25 of file writebuf16.cpp.

13.93.2.4 void WriteBuffer16::WriteVector (K_USHORT ** *ppusBuf_*, K_USHORT * *pusLen_*, K_UCHAR *ucCount_*)

Write a multi-part vector to the circular buffer.

Parameters

*ppusBuf_*	Pointer to the array of source data pointers
*pusLen_*	Array of buffer lengths
*ucCount_*	Number of source-data arrays to write to the buffer

Definition at line 37 of file writebuf16.cpp.

The documentation for this class was generated from the following files:

- /home/moslevin2/mark3/embedded/stage/src/writebuf16.h
- /home/moslevin2/mark3/embedded/stage/src/writebuf16.cpp

Chapter 14

File Documentation

14.1 /home/moslevin2/mark3/embedded/stage/src/blocking.cpp File Reference

Implementation of base class for blocking objects.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "kernel_debug.h"
#include "blocking.h"
#include "thread.h"
```

Macros

- #define **__FILE_ID__** BLOCKING_CPP

14.1.1 Detailed Description

Implementation of base class for blocking objects.

Definition in file blocking.cpp.

14.2 blocking.cpp

```
00001 /*===========================================================================
00002      _____          _____          _____          _____
00003  ___|    _|__   ___|_    |__   ___|__    |__   ___| __   |__   ______
00004 |    \  /   | ||    \       ||      |     ||  |/ /     ||___    |
00005 |     \/    | ||     \      ||      \     ||     \     ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00021 #include "kerneltypes.h"
00022 #include "mark3cfg.h"
00023 #include "kernel_debug.h"
00024
00025 #include "blocking.h"
00026 #include "thread.h"
00027
00028 //---------------------------------------------------------------------------
00029 #if defined __FILE_ID__
00030     #undef __FILE_ID__
00031 #endif
```

```
00032 #define __FILE_ID__     BLOCKING_CPP
00033
00034 #if KERNEL_USE_SEMAPHORE || KERNEL_USE_MUTEX
00035 //---------------------------------------------------------------------------
00036 void BlockingObject::Block(Thread *pclThread_)
00037 {
00038     KERNEL_ASSERT( pclThread_ );
00039     KERNEL_TRACE_1( STR_THREAD_BLOCK_1, (K_USHORT)pclThread_->GetID() );
00040
00041     // Remove the thread from its current thread list (the "owner" list)
00042     // ... And add the thread to this object's block list
00043     Scheduler::Remove(pclThread_);
00044     m_clBlockList.Add(pclThread_);
00045
00046     // Set the "current" list location to the blocklist for this thread
00047     pclThread_->SetCurrent(&m_clBlockList);
00048
00049 }
00050
00051 //---------------------------------------------------------------------------
00052 void BlockingObject::UnBlock(Thread *pclThread_)
00053 {
00054     KERNEL_ASSERT( pclThread_ );
00055     KERNEL_TRACE_1( STR_THREAD_UNBLOCK_1, (K_USHORT)pclThread_->GetID() );
00056
00057     // Remove the thread from its current thread list (the "owner" list)
00058     pclThread_->GetCurrent()->Remove(pclThread_);
00059
00060     // Put the thread back in its active owner's list.  This is usually
00061     // the ready-queue at the thread's original priority.
00062     Scheduler::Add(pclThread_);
00063
00064     // Tag the thread's current list location to its owner
00065     pclThread_->SetCurrent(pclThread_->GetOwner());
00066 }
00067
00068 #endif
```

14.3 /home/moslevin2/mark3/embedded/stage/src/blocking.h File Reference

Blocking object base class declarations.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "ll.h"
#include "threadlist.h"
#include "thread.h"
```

Classes

- class BlockingObject

  Class implementing thread-blocking primatives.

14.3.1 Detailed Description

Blocking object base class declarations. A Blocking object in Mark3 is essentially a thread list. Any blocking object implementation (being a semaphore, mutex, event flag, etc.) can be built on top of this class, utilizing the provided functions to manipulate thread location within the Kernel.

Blocking a thread results in that thread becoming de-scheduled, placed in the blocking object's own private list of threads which are waiting on the object.

Unblocking a thread results in the reverse: The thread is moved back to its original location from the blocking list.

The only difference between a blocking object based on this class is the logic used to determine what consitutes a Block or Unblock condition.

For instance, a semaphore Pend operation may result in a call to the Block() method with the currently-executing

thread in order to make that thread wait for a semaphore Post. That operation would then invoke the UnBlock() method, removing the blocking thread from the semaphore's list, and back into the the appropriate thread inside the scheduler.

Care must be taken when implementing blocking objects to ensure that critical sections are used judiciously, otherwise asynchronous events like timers and interrupts could result in non-deterministic and often catastrophic behavior.

Definition in file blocking.h.

14.4 blocking.h

```
/*===========================================================================
     _____        _____        _____        _____
 ___|    _|__  __|_    |__  __|__   |__  __| __  |__  ______
|    \  /  | ||    \      ||     |     ||  |/ /     ||___   |
|     \/   | ||     \     ||     \     ||  \        ||___   |
|__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||_______|
    |_____|      |_____|      |_____|      |_____|

--[Mark3 Realtime Platform]-------------------------------------------------

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See license.txt for more information
===========================================================================*/
#ifndef __BLOCKING_H__
#define __BLOCKING_H__

#include "kerneltypes.h"
#include "mark3cfg.h"

#include "ll.h"
#include "threadlist.h"
#include "thread.h"

#if KERNEL_USE_MUTEX || KERNEL_USE_SEMAPHORE

//---------------------------------------------------------------------------
class BlockingObject
{
protected:
    void Block(Thread *pclThread_ );

    void UnBlock(Thread *pclThread_);

    ThreadList m_clBlockList;
};

#endif

#endif
```

14.5 /home/moslevin2/mark3/embedded/stage/src/control_button.cpp File Reference

GUI Button Control Implementation.

```
#include "control_button.h"
#include "gui.h"
```

14.5.1 Detailed Description

GUI Button Control Implementation. Basic pushbutton control with an up/down state.

Definition in file control_button.cpp.

14.6 control_button.cpp

```
00001 /*=============================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__   ___|_    |__   ___|__   |__   ___| __  |__   ______
00004 |    \   /  | ||    \       ||      |      ||   |/ /     ||___    |
00005 |     \/    | ||     \      ||      \      ||     \      ||___    |
00006 |__/\__/|__|_||__|\__\  ___||__|\__\  ___||__|\__\  ___||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 =============================================================================*/
00021 #include "control_button.h"
00022 #include "gui.h"
00023
00024
00025 void ButtonControl::Init()
00026 {
00027     m_szCaption = "Button";
00028     m_pstFont = NULL;
00029     m_uBGColor = COLOR_GREY50;
00030     m_uActiveColor = COLOR_GREY25;
00031     m_uLineColor = COLOR_GREY62;
00032     m_uTextColor = COLOR_WHITE;
00033     m_bState = false;
00034     m_pfCallback = NULL;
00035     m_pvCallbackData = NULL;
00036     SetAcceptFocus(true);
00037 }
00038 //---------------------------------------------------------------------------
00039 void ButtonControl::Draw()
00040 {
00041     DrawText_t stText;
00042     DrawLine_t stLine;
00043
00044     GraphicsDriver *pclDriver = GetParentWindow()->
      GetDriver();
00045
00046     K_USHORT usXOffset = 0;
00047     K_USHORT usHalfWidth = 0;
00048     K_USHORT usYOffset = 0;
00049
00050     // Get the location of the control relative to elements higher in the heirarchy
00051     GetControlOffset(&usXOffset, &usYOffset);
00052
00053     // Draw the rounded-off rectangle
00054     stLine.usX1 = GetLeft() + usXOffset;
00055     stLine.usX2 = stLine.usX1 + GetWidth() - 1;
00056     stLine.usY1 = GetTop() + usYOffset;
00057     stLine.usY2 = stLine.usY1;
00058     stLine.uColor = m_uLineColor;
00059     pclDriver->Line(&stLine);
00060
00061     stLine.usY1 = GetTop() + GetHeight() + usYOffset - 1;
00062     stLine.usY2 = stLine.usY1;
00063     pclDriver->Line(&stLine);
00064
00065     stLine.usX1 = GetLeft() + usXOffset;
00066     stLine.usX2 = stLine.usX1;
00067     stLine.usY1 = GetTop() + usYOffset + 1;
00068     stLine.usY2 = GetTop() + GetHeight() - 2;
00069     pclDriver->Line(&stLine);
00070
00071     stLine.usX1 = GetLeft() + GetWidth() + usXOffset - 1;
00072     stLine.usX2 = stLine.usX1;
00073     pclDriver->Line(&stLine);
00074
00075     // Draw a rectangle before the text if the BG is specified.
00076     {
00077         DrawRectangle_t stRect;
00078         stRect.usLeft = GetLeft() + usXOffset + 1;
00079         stRect.usRight = GetLeft() + GetWidth() + usXOffset - 2;
00080         stRect.usTop = GetTop() + usYOffset + 1;
00081         stRect.usBottom = GetTop() + GetHeight() + usYOffset - 2;
00082         stRect.bFill = true;
00083
00084         if (m_bState)
00085         {
00086             stRect.uFillColor = m_uActiveColor;
00087         }
00088         else
00089         {
00090             stRect.uFillColor = m_uBGColor;
```

```
00091         }
00092
00093         if (GetParentWindow()->IsInFocus(this))
00094         {
00095             stRect.uLineColor = m_uLineColor;
00096         }
00097         else
00098         {
00099             stRect.uLineColor = m_uFillColor;
00100         }
00101
00102         pclDriver->Rectangle(&stRect);
00103     }
00104
00105     // Draw the Text
00106     stText.pstFont = m_pstFont;
00107     stText.pcString = m_szCaption;
00108     stText.uColor = m_uTextColor;
00109     usHalfWidth = pclDriver->TextWidth(&stText);
00110     usHalfWidth >>= 1;
00111     stText.usLeft = GetLeft() + (GetWidth()>>1) - usHalfWidth + usXOffset;
00112     stText.usTop = GetTop() + usYOffset;
00113     pclDriver->Text(&stText);
00114 }
00115
00116 //---------------------------------------------------------------------------
00117 GuiReturn_t ButtonControl::ProcessEvent(
      GuiEvent_t *pstEvent_ )
00118 {
00119     K_USHORT usXOffset, usYOffset;
00120
00121     GetControlOffset(&usXOffset, &usYOffset);
00122
00123     GUI_DEBUG_PRINT("ButtonControl::ProcessEvent\n");
00124
00125     switch (pstEvent_->ucEventType)
00126     {
00127         case EVENT_TYPE_KEYBOARD:
00128         {
00129             // If this is a space bar or an enter key, behave like a mouse click.
00130             if ((KEYCODE_SPACE == pstEvent_->stKey.ucKeyCode) ||
00131                 (KEYCODE_RETURN == pstEvent_->stKey.ucKeyCode))
00132             {
00133                 if (pstEvent_->stKey.bKeyState)
00134                 {
00135                     m_bState = true;
00136                 }
00137                 else
00138                 {
00139                     m_bState = false;
00140                     if (m_pfCallback)
00141                     {
00142                         m_pfCallback(m_pvCallbackData);
00143                     }
00144                 }
00145                 SetStale();
00146             }
00147         }
00148             break;
00149         case EVENT_TYPE_MOUSE:
00150         {
00151             // Is this control currently in the "active"/pressed state?
00152             if (m_bState)
00153             {
00154                 // Check to see if the movement is out-of-bounds based on the coordinates.
00155                 // If so, de-activate the control
00156                 if (pstEvent_->stMouse.bLeftState)
00157                 {
00158                     if ((pstEvent_->stMouse.usX < GetLeft() + usXOffset) ||
00159                         (pstEvent_->stMouse.usX >= GetLeft() + usXOffset +
      GetWidth()-1) ||
00160                         (pstEvent_->stMouse.usY < GetTop() + usYOffset) ||
00161                         (pstEvent_->stMouse.usY >= GetTop() + usYOffset +
      GetHeight() - 1))
00162                     {
00163                         m_bState = false;
00164                         SetStale();
00165                     }
00166                 }
00167                 // left button state is now up, and the control was previously active.
00168                 // Run the event callback for the mouse, and go from there.
00169                 else
00170                 {
00171                     if ((pstEvent_->stMouse.usX >= GetLeft() + usXOffset) &&
00172                         (pstEvent_->stMouse.usX < GetLeft() + usXOffset +
      GetWidth()-1) &&
00173                         (pstEvent_->stMouse.usY >= GetTop() + usYOffset) &&
```

```
00174                           (pstEvent_->stMouse.usY < GetTop() + usYOffset +
      GetHeight() - 1))
00175                       {
00176                           m_bState = false;
00177                           SetStale();
00178                           if (m_pfCallback)
00179                           {
00180                               m_pfCallback(m_pvCallbackData);
00181                           }
00182                       }
00183                   }
00184               }
00185               else if (!m_bState)
00186               {
00187                   // If we registered a down-click in the bounding box, set the state of the
00188                   // control to activated.
00189                   if (pstEvent_->stMouse.bLeftState)
00190                   {
00191                       if ((pstEvent_->stMouse.usX >= GetLeft() + usXOffset) &&
00192                           (pstEvent_->stMouse.usX < GetLeft() + usXOffset +
      GetWidth()-1) &&
00193                           (pstEvent_->stMouse.usY >= GetTop() + usYOffset) &&
00194                           (pstEvent_->stMouse.usY < GetTop() + usYOffset +
      GetHeight() - 1))
00195                       {
00196                           m_bState = true;
00197                           SetStale();
00198                       }
00199                   }
00200               }
00201
00202               if (!IsInFocus())
00203               {
00204                   GetParentWindow()->SetFocus(this);
00205                   SetStale();
00206               }
00207
00208           }
00209               break;
00210       }
00211
00212   }
00213
00214   //---------------------------------------------------------------------------
00215   void ButtonControl::Activate( bool bActivate_ )
00216   {
00217       // When we de-activate the control, simply disarm the control and force
00218       // a redraw
00219       if (!bActivate_)
00220       {
00221           m_bState = false;
00222       }
00223       SetStale();
00224   }
```

14.7 /home/moslevin2/mark3/embedded/stage/src/control_button.h File Reference

GUI Button Control.

```
#include "gui.h"
#include "kerneltypes.h"
#include "draw.h"
#include "font.h"
```

Classes

- class ButtonControl

Typedefs

- typedef void(* **ButtonCallback**)(void *pvData_)

14.7.1 Detailed Description

GUI Button Control. Basic pushbutton control with an up/down state.

Definition in file control_button.h.

14.8 control_button.h

```
00001
00002 /*===========================================================================
00003      _____          _____          _____          _____
00004  ___|    _|__   ___|_    |__   ___|__   |__   ___| __   |__   ______
00005 |    \  /  | ||    \       ||      |     ||  |/ /     ||___   |
00006 |     \/   | ||     \      ||      \     ||     \     ||___   |
00007 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00008    |_____|       |_____|       |_____|       |_____|
00009
00010 --[Mark3 Realtime Platform]-----------------------------------------------
00011
00012 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00013 See license.txt for more information
00014 ===========================================================================*/
00022 #ifndef __CONTROL_BUTTON_H__
00023 #define __CONTROL_BUTTON_H__
00024
00025 #include "gui.h"
00026 #include "kerneltypes.h"
00027 #include "draw.h"
00028 #include "font.h"
00029
00030 typedef void (*ButtonCallback)( void *pvData_ );
00031
00032 class ButtonControl : public GuiControl
00033 {
00034 public:
00035
00036     virtual void Init();
00037     virtual void Draw();
00038     virtual GuiReturn_t ProcessEvent( GuiEvent_t *pstEvent_ );
00039     virtual void Activate( bool bActivate_ );
00040
00041     void SetBGColor( COLOR eColor_ )        { m_uBGColor = eColor_; }
00042     void SetLineColor( COLOR eColor_ )      { m_uLineColor = eColor_; }
00043     void SetFillColor( COLOR eColor_ )      { m_uFillColor = eColor_; }
00044     void SetTextColor( COLOR eColor_ )      { m_uTextColor = eColor_; }
00045     void SetActiveColor( COLOR eColor_ )    { m_uActiveColor = eColor_; }
00046
00047     void SetFont( Font_t *pstFont_ )        { m_pstFont = pstFont_; }
00048
00049     void SetCaption( const K_CHAR *szCaption_ )     { m_szCaption = szCaption_;}
00050
00051     void SetCallback( ButtonCallback pfCallback_, void *pvData_ )
00052         { m_pfCallback = pfCallback_; m_pvCallbackData = pvData_; }
00053 private:
00054
00055     const K_CHAR *m_szCaption;
00056     Font_t *m_pstFont;
00057     COLOR   m_uBGColor;
00058     COLOR   m_uActiveColor;
00059     COLOR   m_uLineColor;
00060     COLOR   m_uFillColor;
00061     COLOR   m_uTextColor;
00062     bool    m_bState;
00063
00064     void *m_pvCallbackData;
00065     ButtonCallback m_pfCallback;
00066 };
00067
00068
00069 #endif
00070
```

14.9 /home/moslevin2/mark3/embedded/stage/src/control_checkbox.cpp File Reference

Checkbox Control.

```
#include "gui.h"
#include "kerneltypes.h"
#include "draw.h"
#include "font.h"
#include "control_checkbox.h"
```

Macros

- #define **TEXT_X_OFFSET** (13)

Variables

- static const K_UCHAR **aucBox** []
- static const K_UCHAR **aucCheck** []

14.9.1 Detailed Description

Checkbox Control. A binary On/Off switch control

Definition in file control_checkbox.cpp.

14.9.2 Variable Documentation

14.9.2.1 const K_UCHAR aucBox[] [static]

Initial value:

```
=
{ 0x7E,
  0x81,
  0x81,
  0x81,
  0x81,
  0x81,
  0x81,
  0x7E }
```

Definition at line 31 of file control_checkbox.cpp.

14.9.2.2 const K_UCHAR aucCheck[] [static]

Initial value:

```
=
{ 0,
  0,
  0x3C,
  0x3C,
  0x3C,
  0x3C,
  0,
  0 }
```

Definition at line 42 of file control_checkbox.cpp.

14.10 control_checkbox.cpp

```
00001 /*============================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__   ___|_    |__   ___|__   |__   ___| __  |__   ______
00004 |    \  /  | ||    \       ||      |     ||  |/ /     ||___   |
00005 |     \/   | ||     \      ||      \     ||     \     ||___   |
00006 |__/\__/|__|_||__|\__\  ___||__|\__\  ___||__|\__\  ___||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ============================================================================*/
00021 #include "gui.h"
00022 #include "kerneltypes.h"
00023 #include "draw.h"
00024 #include "font.h"
00025 #include "control_checkbox.h"
00026
00027 //---------------------------------------------------------------------------
00028 #define TEXT_X_OFFSET       (13)
00029
00030 //---------------------------------------------------------------------------
00031 static const K_UCHAR aucBox[] =
00032 { 0x7E,
00033   0x81,
00034   0x81,
00035   0x81,
00036   0x81,
00037   0x81,
00038   0x81,
00039   0x7E };
00040
00041 //---------------------------------------------------------------------------
00042 static const K_UCHAR aucCheck[] =
00043 { 0,
00044   0,
00045   0x3C,
00046   0x3C,
00047   0x3C,
00048   0x3C,
00049   0,
00050   0 };
00051
00052 //---------------------------------------------------------------------------
00053 void CheckBoxControl::Init()
00054 {
00055     SetAcceptFocus(true);
00056 }
00057
00058 //---------------------------------------------------------------------------
00059 void CheckBoxControl::Draw()
00060 {
00061     GraphicsDriver *pclDriver = GetParentWindow()->
      GetDriver();
00062     K_USHORT usX, usY;
00063     K_USHORT usTextWidth;
00064
00065     GetControlOffset(&usX, &usY);
00066
00067     // Draw the box, (and check, if necessary)
00068     {
00069         DrawRectangle_t stRect;
00070
00071         if (GetParentWindow()->IsInFocus(this))
00072         {
00073             stRect.uLineColor = m_uActiveColor;
00074         }
00075         else
00076         {
00077             stRect.uLineColor = m_uBackColor;
00078         }
00079
00080         stRect.uFillColor = m_uBackColor;
00081         stRect.usTop = usY + GetTop();
00082         stRect.usLeft = usX + GetLeft();
00083         stRect.usRight = stRect.usLeft + GetWidth() - 1;
00084         stRect.usBottom = stRect.usTop + GetHeight() - 1;
00085         stRect.bFill = true;
00086         pclDriver->Rectangle(&stRect);
00087
00088         stRect.uLineColor = m_uBoxBGColor;
00089         stRect.uFillColor = m_uBoxBGColor;
00090         stRect.usTop = usY + GetTop() + ((GetHeight() - 5) >> 1) - 1;
```

```
00091         stRect.usLeft = usX + GetLeft() + 2;
00092         stRect.usRight = stRect.usLeft + 7;
00093         stRect.usBottom = stRect.usTop + 7;
00094         stRect.bFill = true;
00095         pclDriver->Rectangle(&stRect);
00096     }
00097 
00098     {
00099         DrawStamp_t stStamp;
00100         stStamp.uColor = m_uBoxColor;
00101         stStamp.usY = usY + GetTop() + ((GetHeight() - 5) >> 1) - 1;
00102         stStamp.usX = usX + GetLeft() + 2;
00103         stStamp.usWidth = 8;
00104         stStamp.usHeight = 8;
00105         stStamp.pucData = (K_UCHAR*)aucBox;
00106         pclDriver->Stamp(&stStamp);
00107 
00108         if (m_bChecked)
00109         {
00110             stStamp.pucData = (K_UCHAR*)aucCheck;
00111             pclDriver->Stamp(&stStamp);
00112         }
00113     }
00114 
00115     // Draw the caption
00116     {
00117         DrawText_t stText;
00118         stText.usLeft = usX + GetLeft() + TEXT_X_OFFSET;
00119         stText.usTop = usY + GetTop();
00120         stText.uColor = m_uFontColor;
00121         stText.pstFont = m_pstFont;
00122         stText.pcString = m_szCaption;
00123 
00124         usTextWidth = pclDriver->TextWidth(&stText);
00125         pclDriver->Text(&stText);
00126     }
00127 }
00128 
00129 //---------------------------------------------------------------------------
00130 GuiReturn_t CheckBoxControl::ProcessEvent(
      GuiEvent_t *pstEvent_ )
00131 {
00132     K_USHORT usXOffset, usYOffset;
00133 
00134     GetControlOffset(&usXOffset, &usYOffset);
00135 
00136     GUI_DEBUG_PRINT("ButtonControl::ProcessEvent\n");
00137 
00138     switch (pstEvent_->ucEventType)
00139     {
00140         case EVENT_TYPE_KEYBOARD:
00141         {
00142             // If this is a space bar or an enter key, behave like a mouse click.
00143             if ((KEYCODE_SPACE == pstEvent_->stKey.ucKeyCode) ||
00144                 (KEYCODE_RETURN == pstEvent_->stKey.ucKeyCode))
00145             {
00146                 if (pstEvent_->stKey.bKeyState)
00147                 {
00148                     m_bChecked = true;
00149                 }
00150                 else
00151                 {
00152                     m_bChecked = false;
00153                 }
00154                 SetStale();
00155             }
00156         }
00157             break;
00158         case EVENT_TYPE_MOUSE:
00159         {
00160             // Is this control currently in the "active"/pressed state?
00161             if (m_bChecked)
00162             {
00163                 // Check to see if the movement is out-of-bounds based on the coordinates.
00164                 // If so, de-activate the control
00165                 if (pstEvent_->stMouse.bLeftState)
00166                 {
00167                     if ((pstEvent_->stMouse.usX >= GetLeft() + usXOffset) &&
00168                         (pstEvent_->stMouse.usX < GetLeft() + usXOffset +
      GetWidth()-1) &&
00169                         (pstEvent_->stMouse.usY >= GetTop() + usYOffset) &&
00170                         (pstEvent_->stMouse.usY < GetTop() + usYOffset +
      GetHeight() - 1))
00171                     {
00172                         m_bChecked = false;
00173                         SetStale();
00174                     }
```

```
00175                 }
00176             }
00177             else if (!m_bChecked)
00178             {
00179                 // If we registered a down-click in the bounding box, set the state of the
00180                 // control to activated.
00181                 if (pstEvent_->stMouse.bLeftState)
00182                 {
00183                     if ((pstEvent_->stMouse.usX >= GetLeft() + usXOffset) &&
00184                         (pstEvent_->stMouse.usX < GetLeft() + usXOffset +
      GetWidth()-1) &&
00185                         (pstEvent_->stMouse.usY >= GetTop() + usYOffset) &&
00186                         (pstEvent_->stMouse.usY < GetTop() + usYOffset +
      GetHeight() - 1))
00187                     {
00188                         m_bChecked = true;
00189                         SetStale();
00190                     }
00191                 }
00192             }
00193 
00194             if (!IsInFocus())
00195             {
00196                 GetParentWindow()->SetFocus(this);
00197                 SetStale();
00198             }
00199         }
00200             break;
00201     }
00202 }
```

14.11 /home/moslevin2/mark3/embedded/stage/src/control_checkbox.h File Reference

Checkbox Control.

```
#include "gui.h"
#include "kerneltypes.h"
#include "draw.h"
#include "font.h"
```

Classes

- class CheckBoxControl

14.11.1 Detailed Description

Checkbox Control. A binary On/Off switch control

Definition in file control_checkbox.h.

14.12 control_checkbox.h

```
00001 /*===========================================================================
00002       _____          _____          _____          _____
00003  ____|     |__   ___|_    |__   ___|__   |__   ___|  __  |__   ______
00004 |     \   /  | ||     \       ||      |     ||   |/ /     ||___    |
00005 |      \/    | ||      \      ||      \     ||      \      ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008 
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010 
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00021 #ifndef __CONTROL_CHECKBOX_H__
00022 #define __CONTROL_CHECKBOX_H__
00023 
```

```
00024 #include "gui.h"
00025 #include "kerneltypes.h"
00026 #include "draw.h"
00027 #include "font.h"
00028
00029 class CheckBoxControl : public GuiControl
00030 {
00031 public:
00032     virtual void Init();
00033     virtual void Draw();
00034     virtual GuiReturn_t ProcessEvent( GuiEvent_t *pstEvent_ );
00035     virtual void Activate( bool bActivate_ )  { SetStale(); }
00036
00037     void SetFont( Font_t *pstFont_ )        { m_pstFont    = pstFont_; }
00038     void SetCaption( const char *szCaption_ ) { m_szCaption = szCaption_; }
00039     void SetCheck( bool bChecked_ )           { m_bChecked   = bChecked_; }
00040     void SetFontColor( COLOR uFontColor_ )    { m_uFontColor = uFontColor_; }
00041     void SetBoxColor( COLOR uBoxColor_ )      { m_uBoxColor  = uBoxColor_; }
00042     void SetBackColor( COLOR uBackColor_ )    { m_uBackColor = uBackColor_; }
00043     bool IsChecked( void )                    { return m_bChecked; }
00044
00045 private:
00046     const char *m_szCaption;
00047     COLOR m_uBackColor;
00048     COLOR m_uBoxColor;
00049     COLOR m_uFontColor;
00050     Font_t *m_pstFont;
00051     bool m_bChecked;
00052 };
00053
00054 #endif
00055
```

14.13 /home/moslevin2/mark3/embedded/stage/src/control_gamepanel.cpp File Reference

GUI Panel Control Implementation with joystick control and tick-based state machine updates.

```
#include "gui.h"
#include "kerneltypes.h"
#include "draw.h"
#include "graphics.h"
#include "control_gamepanel.h"
```

14.13.1 Detailed Description

GUI Panel Control Implementation with joystick control and tick-based state machine updates.

Definition in file control_gamepanel.cpp.

14.14 control_gamepanel.cpp

```
00001 /*===========================================================================
00002      _____        _____        _____        _____
00003  ___|     |_   __|_    |__  __|__   |__  __| __  |__  ______
00004 |     \   /  | ||     \      ||      |     ||  |/ /     ||___   |
00005 |      \/    | ||      \     ||      \     ||     \     ||___   |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00020 #include "gui.h"
00021 #include "kerneltypes.h"
00022 #include "draw.h"
00023 #include "graphics.h"
00024 #include "control_gamepanel.h"
```

```
00025
00026 //---------------------------------------------------------------------------
00027 void GamePanelControl::Draw()
00028 {
00029     // Game state machine goes here.
00030 }
00031
00032 //---------------------------------------------------------------------------
00033 GuiReturn_t GamePanelControl::ProcessEvent(
      GuiEvent_t *pstEvent_ )
00034 {
00035     K_USHORT usXOffset, usYOffset;
00036
00037     switch (pstEvent_->ucEventType)
00038     {
00039         case EVENT_TYPE_TIMER:
00040             // Every tick, call Draw().  This is used to kick the state
00041             // machine
00042             SetStale();
00043             break;
00044         case EVENT_TYPE_KEYBOARD:
00045             break;
00046         case EVENT_TYPE_MOUSE:
00047             break;
00048         case EVENT_TYPE_JOYSTICK:
00049             m_stLastJoy.usRawData = m_stCurrentJoy.usRawData;
00050             m_stCurrentJoy.usRawData = pstEvent_->stJoystick.
      usRawData;
00051             break;
00052     }
00053     return GUI_EVENT_OK;
00054 }
```

14.15 /home/moslevin2/mark3/embedded/stage/src/control_gamepanel.h File Reference

GUI Game Panel Control.

```
#include "gui.h"
#include "kerneltypes.h"
#include "draw.h"
```

Classes

- class GamePanelControl

14.15.1 Detailed Description

GUI Game Panel Control. A game panel is a blank UI element whose dimensions define the dimensions of a gameplay surface. The element triggers a draw() call on every tick event (which can be used to kick a game's state machine). The control also responds to joystick events, which can then be used to control the game.

Definition in file control_gamepanel.h.

14.16 control_gamepanel.h

```
00001 /*===========================================================================
00002     _____       _____       _____       _____
00003  ___|    _|__  __|_    |__  __|__   |__  __| __  |__  ______
00004 |    \  /  | ||    \      ||     |     ||  |/ /     ||___   |
00005 |     \/   | ||     \     ||     \     ||     \     ||___   |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]-----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
```

```
00025 #ifndef __CONTROL_GAMEPANEL_H__
00026 #define __CONTROL_GAMEPANEL_H__
00027
00028 #include "gui.h"
00029 #include "kerneltypes.h"
00030 #include "draw.h"
00031
00032 class GamePanelControl : public GuiControl
00033 {
00034 public:
00035     virtual void Init() { SetAcceptFocus(false); m_stCurrentJoy.
      usRawData = 0; m_stLastJoy.usRawData = 0;}
00036     virtual void Draw();
00037     virtual GuiReturn_t ProcessEvent( GuiEvent_t *pstEvent_ );
00038     virtual void Activate( bool bActivate_ ) {}
00039
00040 private:
00041     JoystickEvent_t m_stLastJoy;
00042     JoystickEvent_t m_stCurrentJoy;
00043
00044 };
00045
00046 #endif
00047
```

14.17 /home/moslevin2/mark3/embedded/stage/src/control_groupbox.cpp File Reference

GUI GroupBox Control Implementation.

```
#include "gui.h"
#include "kerneltypes.h"
#include "draw.h"
#include "graphics.h"
#include "control_groupbox.h"
```

Macros

- #define **BORDER_OFFSET** (4)
- #define **TEXT_X_OFFSET** (8)
- #define **TEXT_Y_OFFSET** (0)

14.17.1 Detailed Description

GUI GroupBox Control Implementation.

Definition in file control_groupbox.cpp.

14.18 control_groupbox.cpp

```
00001 /*=============================================================================
00002     _____       _____       _____       _____
00003  ___|    _|__  __|_    |__  __|__    |__  __| __  |__  ______
00004 |    \  /  | ||    \      ||     |     ||  |/ /     ||___   |
00005 |     \/   | ||     \     ||     \     ||     \     ||___   |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007    |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00019 #include "gui.h"
00020 #include "kerneltypes.h"
00021 #include "draw.h"
00022 #include "graphics.h"
00023 #include "control_groupbox.h"
```

```
00024
00025 #define BORDER_OFFSET           (4)
00026 #define TEXT_X_OFFSET           (8)
00027 #define TEXT_Y_OFFSET           (0)
00028
00029 //---------------------------------------------------------------------------
00030 void GroupBoxControl::Draw()
00031 {
00032     GUI_DEBUG_PRINT( "GroupBoxControl::Draw()\n");
00033     GraphicsDriver *pclDriver = GetParentWindow()->
      GetDriver();
00034     K_USHORT usX, usY;
00035     K_USHORT usTextWidth;
00036
00037     GetControlOffset(&usX, &usY);
00038
00039     // Draw the background panel
00040     {
00041         DrawRectangle_t stRectangle;
00042         stRectangle.usTop = GetTop() + usY;
00043         stRectangle.usBottom = stRectangle.usTop + GetHeight() -1;
00044         stRectangle.usLeft = GetLeft() + usX;
00045         stRectangle.usRight = stRectangle.usLeft + GetWidth() -1;
00046         stRectangle.bFill = true;
00047         stRectangle.uLineColor = m_uPanelColor;
00048         stRectangle.uFillColor = m_uPanelColor;
00049
00050         pclDriver->Rectangle(&stRectangle);
00051     }
00052
00053     // Draw the caption
00054     {
00055         DrawText_t stText;
00056         stText.usLeft = usX + TEXT_X_OFFSET;
00057         stText.usTop = usY + TEXT_Y_OFFSET;
00058         stText.uColor = m_uFontColor;
00059         stText.pstFont = m_pstFont;
00060         stText.pcString = m_pcCaption;
00061
00062         usTextWidth = pclDriver->TextWidth(&stText);
00063         pclDriver->Text(&stText);
00064     }
00065
00066     // Draw the lines surrounding the panel
00067     {
00068         DrawLine_t stLine;
00069
00070         stLine.uColor = m_uLineColor;
00071         stLine.usY1 = GetTop() + usY + BORDER_OFFSET;
00072         stLine.usY2 = GetTop() + usY + GetHeight() - BORDER_OFFSET - 1;
00073         stLine.usX1 = usX + BORDER_OFFSET;
00074         stLine.usX2 = usX + BORDER_OFFSET;
00075         pclDriver->Line(&stLine);
00076
00077         stLine.usY1 = GetTop() + usY + BORDER_OFFSET;
00078         stLine.usY2 = GetTop() + usY + GetHeight() - BORDER_OFFSET - 1;
00079         stLine.usX1 = usX + GetWidth() - BORDER_OFFSET - 1;
00080         stLine.usX2 = usX + GetWidth() - BORDER_OFFSET - 1;
00081         pclDriver->Line(&stLine);
00082
00083         stLine.usY1 = GetTop() + usY + GetHeight() - BORDER_OFFSET - 1;
00084         stLine.usY2 = GetTop() + usY + GetHeight() - BORDER_OFFSET - 1;
00085         stLine.usX1 = usX + BORDER_OFFSET;
00086         stLine.usX2 = usX + GetWidth() - BORDER_OFFSET - 1;
00087         pclDriver->Line(&stLine);
00088
00089         stLine.usY1 = GetTop() + BORDER_OFFSET - 1;
00090         stLine.usY2 = GetTop() + BORDER_OFFSET - 1;
00091         stLine.usX1 = usX + BORDER_OFFSET;
00092         stLine.usX2 = usX + TEXT_X_OFFSET - 2;
00093         pclDriver->Line(&stLine);
00094
00095         stLine.usX1 = usX + TEXT_X_OFFSET + usTextWidth;
00096         stLine.usX2 = usX + GetWidth() - BORDER_OFFSET - 1;
00097         pclDriver->Line(&stLine);
00098     }
00099
00100
00101 }
```

14.19 /home/moslevin2/mark3/embedded/stage/src/control_groupbox.h File Reference

GUI Group Box Control.

```
#include "gui.h"
#include "kerneltypes.h"
#include "draw.h"
```

Classes

- class GroupBoxControl

14.19.1 Detailed Description

GUI Group Box Control. A groupbox control is essentially a panel with a text caption, and a lined border.

Definition in file control_groupbox.h.

14.20 control_groupbox.h

```
/*===========================================================================
     _____       _____       _____       _____
 ___|    _|__  __|_    |__  __|__   |__  __| __  |__  ______
|    \  /  | ||    \      ||     |     ||  |/ /     ||___   |
|     \/   | ||     \     ||     \     ||  \        ||___   |
|__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
    |_____|      |_____|      |_____|      |_____|

--[Mark3 Realtime Platform]--------------------------------------------------

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===========================================================================*/
#ifndef __CONTROL_GROUPBOX_H__
#define __CONTROL_GROUPBOX_H__

#include "gui.h"
#include "kerneltypes.h"
#include "draw.h"

class GroupBoxControl : public GuiControl
{
public:
    virtual void Init() { m_uLineColor = COLOR_BLACK;
                          m_uFontColor = COLOR_GREY25;
                          m_uPanelColor = COLOR_GREY75;
                          SetAcceptFocus(false); }
    virtual void Draw();
    virtual GuiReturn_t ProcessEvent( GuiEvent_t *pstEvent_ ) {};
    virtual void Activate( bool bActivate_ ) {}

    void SetPanelColor( COLOR eColor_ ) { m_uPanelColor = eColor_; }
    void SetLineColor( COLOR eColor_ ) { m_uLineColor = eColor_; }
    void SetFontColor( COLOR eColor_ ) { m_uFontColor = eColor_; }
    void SetFont( Font_t *pstFont_ ) { m_pstFont = pstFont_; }
    void SetCaption( const K_CHAR *pcCaption_ ) { m_pcCaption = pcCaption_; }
private:
    COLOR m_uPanelColor;
    COLOR m_uLineColor;
    COLOR m_uFontColor;

    Font_t *m_pstFont;
    const K_CHAR *m_pcCaption;
};

#endif

```

14.21 /home/moslevin2/mark3/embedded/stage/src/control_label.h File Reference

GUI Label Control.

```
#include "gui.h"
#include "kerneltypes.h"
#include "draw.h"
#include "font.h"
```

Classes

- class LabelControl

14.21.1 Detailed Description

GUI Label Control. A label control is a static text eliment, specified by a font, a color, and a string to overlay at a given location.

Definition in file control_label.h.

14.22 control_label.h

```
00001 /*=============================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__   ___|_    |__   ___|__   |__   ___| __  |__   ______
00004 |    \  /   | ||    \       ||      |      ||  |/ /     ||___    |
00005 |     \/    | ||     \      ||      \      ||     \     ||___    |
00006 |__/\__/|__|_||__|\__\  ___||__|\__\  ___||__|\__\  ___||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 =============================================================================*/
00022 #ifndef __CONTROL_LABEL_H__
00023 #define __CONTROL_LABEL_H__
00024
00025 #include "gui.h"
00026 #include "kerneltypes.h"
00027 #include "draw.h"
00028 #include "font.h"
00029
00030 class LabelControl : public GuiControl
00031 {
00032 public:
00033     virtual void Init() { m_uBackColor = COLOR_BLACK;
00034                           m_uFontColor = COLOR_WHITE;
00035                           m_pstFont = NULL;
00036                           m_pcCaption = "";
00037                           SetAcceptFocus(false); }
00038     virtual void Draw();
00039     virtual GuiReturn_t ProcessEvent( GuiEvent_t *pstEvent_ ) {}
00040     virtual void Activate( bool bActivate_ ) {}
00041
00042     void SetBackColor( COLOR eColor_ )          { m_uBackColor = eColor_; }
00043     void SetFontColor( COLOR eColor_ )          { m_uFontColor = eColor_; }
00044     void SetFont( Font_t *pstFont_ )          { m_pstFont = pstFont_; }
00045     void SetCaption( const K_CHAR *pcData_ )    { m_pcCaption = pcData_; }
00046
00047 private:
00048     Font_t *m_pstFont;
00049     const K_CHAR *m_pcCaption;
00050     COLOR m_uBackColor;
00051     COLOR m_uFontColor;
00052
00053 };
00054
00055 #endif
00056
```

14.23 /home/moslevin2/mark3/embedded/stage/src/control_notification.cpp File Reference

Notification pop-up control.

```
#include "control_notification.h"
#include "kerneltypes.h"
```

14.23.1 Detailed Description

Notification pop-up control. A pop-up control that can be used to present the user with information about system state changes, events, etc.

Definition in file control_notification.cpp.

14.24 control_notification.cpp

```
00001 /*===========================================================================
00002      _____          _____          _____          _____
00003  ___|    _|__   ___|_    |__   ___|__    |__   ___| __   |__   ______
00004 |    \  /  | ||    \       ||      |     ||  |/ /     ||___    |
00005 |     \/   | ||     \      ||      \     ||     \     ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00022 #include "control_notification.h"
00023 #include "kerneltypes.h"
00024
00025 //---------------------------------------------------------------------------
00026 void NotificationControl::Draw()
00027 {
00028     if (!m_bVisible)
00029     {
00030         return;
00031     }
00032
00033     DrawRectangle_t stRect;
00034     DrawLine_t stLine;
00035     DrawText_t stText;
00036
00037     GraphicsDriver *pclDriver = GetParentWindow()->
      GetDriver();
00038
00039     K_USHORT usXOffset = 0;
00040     K_USHORT usHalfWidth = 0;
00041     K_USHORT usYOffset = 0;
00042
00043     // Get the location of the control relative to elements higher in the heirarchy
00044     GetControlOffset(&usXOffset, &usYOffset);
00045
00046     // Draw the rounded-off rectangle
00047     stLine.usX1 = GetLeft() + usXOffset + 1;
00048     stLine.usX2 = stLine.usX1 + GetWidth() - 3;
00049     stLine.usY1 = GetTop() + usYOffset;
00050     stLine.usY2 = stLine.usY1;
00051     stLine.uColor = COLOR_WHITE;
00052     pclDriver->Line(&stLine);
00053
00054     stLine.usY1 = GetTop() + usYOffset + GetHeight() - 1;
00055     stLine.usY2 = stLine.usY1;
00056     pclDriver->Line(&stLine);
00057
00058     // Draw the rounded-off rectangle
00059     stLine.usX1 = GetLeft() + usXOffset ;
00060     stLine.usX2 = stLine.usX1;
00061
00062     stLine.usY1 = GetTop() + usYOffset + 1;
00063     stLine.usY2 = stLine.usY1 + GetHeight() - 3;
00064     pclDriver->Line(&stLine);
```

```
00065
00066     // Draw the rounded-off rectangle
00067     stLine.usX1 = GetLeft() + usXOffset + GetWidth() - 1;
00068     stLine.usX2 = stLine.usX1;
00069     pclDriver->Line(&stLine);
00070
00071     stRect.usTop = GetTop() + usYOffset + 1;
00072     stRect.usBottom = stRect.usTop + GetHeight() - 3;
00073     stRect.usLeft = GetLeft() + usXOffset + 1;
00074     stRect.usRight = stRect.usLeft + GetWidth() - 3;
00075     stRect.bFill = true;
00076     stRect.uFillColor = COLOR_BLACK;
00077     stRect.uLineColor = COLOR_BLACK;
00078     pclDriver->Rectangle(&stRect);
00079
00080     // Draw the Text
00081     stText.pstFont = m_pstFont;
00082     stText.pcString = m_szCaption;
00083     stText.uColor = COLOR_WHITE;
00084     usHalfWidth = pclDriver->TextWidth(&stText);
00085     usHalfWidth >>= 1;
00086     stText.usLeft = GetLeft() + (GetWidth()>>1) - usHalfWidth + usXOffset;
00087     stText.usTop = GetTop() + usYOffset;
00088     pclDriver->Text(&stText);
00089 }
00090
00091 //---------------------------------------------------------------------------
00092 GuiReturn_t NotificationControl::ProcessEvent(
      GuiEvent_t *pstEvent_ )
00093 {
00094
00095     switch (pstEvent_->ucEventType)
00096     {
00097         case EVENT_TYPE_TIMER:
00098         {
00099             if (m_bTrigger && m_usTimeout)
00100             {
00101                 m_usTimeout--;
00102
00103                 if (!m_usTimeout)
00104                 {
00105                     m_bVisible = false;
00106                     m_bTrigger = false;
00107                     SetStale();
00108
00109                     K_USHORT usX, usY;
00110                     GetControlOffset(&usX, &usY);
00111
00112                     GetParentWindow()->InvalidateRegion(
      GetLeft() + usX, GetTop() + usY, GetWidth(), GetHeight());
00113                 }
00114             }
00115
00116             break;
00117         }
00118         default:
00119             break;
00120     }
00121 }
```

14.25 /home/moslevin2/mark3/embedded/stage/src/control_notification.h File Reference

Notification pop-up control.

```
#include "gui.h"
#include "kerneltypes.h"
#include "draw.h"
```

Classes

- class NotificationControl

14.25.1 Detailed Description

Notification pop-up control. A pop-up control that can be used to present the user with information about system state changes, events, etc.

Definition in file control_notification.h.

14.26 control_notification.h

```
00001 /*=============================================================================
00002     _____       _____       _____       _____
00003  ___|    _|__  __|_    |__  __|__    |__  __| __  |__  ______
00004 |    \  /  | ||    \      ||     |     ||  |/ /     ||___   |
00005 |     \/   | ||     \     ||     \     ||     \     ||___   |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00022 #ifndef __CONTROL_NOTIFICATION_H__
00023 #define __CONTROL_NOTIFICATION_H__
00024
00025 #include "gui.h"
00026 #include "kerneltypes.h"
00027 #include "draw.h"
00028
00029 class NotificationControl : public GuiControl
00030 {
00031 public:
00032     virtual void Init()
00033     {
00034         SetAcceptFocus(false);
00035         m_szCaption = "";
00036         m_pstFont = NULL;
00037         m_bVisible = true;
00038         m_bTrigger = false;
00039     }
00040
00041     virtual void Draw();
00042     virtual GuiReturn_t ProcessEvent( GuiEvent_t *pstEvent_ );
00043     virtual void Activate( bool bActivate_ ) {}
00044
00045     void SetFont( Font_t *pstFont_ ) { m_pstFont = pstFont_; }
00046     void SetCaption( const K_CHAR *szCaption_ ) { m_szCaption = szCaption_; }
00047
00048     void Trigger( K_USHORT usTimeout_ )
00049     {
00050         m_usTimeout = usTimeout_;
00051         m_bTrigger = true;
00052         m_bVisible = true;
00053         SetStale();
00054     }
00055
00056 private:
00057     const K_CHAR * m_szCaption;
00058     Font_t *m_pstFont;
00059     K_USHORT m_usTimeout;
00060     bool m_bTrigger;
00061     bool m_bVisible;
00062 };
00063
00064 #endif
00065
```

14.27 /home/moslevin2/mark3/embedded/stage/src/control_panel.cpp File Reference

GUI Panel Control Implementation.

```
#include "gui.h"
#include "kerneltypes.h"
#include "draw.h"
#include "graphics.h"
#include "control_panel.h"
```

14.27.1 Detailed Description

GUI Panel Control Implementation.

Definition in file control_panel.cpp.

14.28 control_panel.cpp

```
00001 /*=============================================================================
00002         _____          _____          _____          _____
00003  ___|    _|__  __|_    |__  __|__    |__  __| __  __| __  |__  ______
00004 |    \  /  | ||    \       ||     |     ||  |/ /     ||___    |
00005 |     \/   | ||     \      ||     \     ||     \     ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 =============================================================================*/
00019 #include "gui.h"
00020 #include "kerneltypes.h"
00021 #include "draw.h"
00022 #include "graphics.h"
00023 #include "control_panel.h"
00024
00025 //---------------------------------------------------------------------------
00026 void PanelControl::Draw()
00027 {
00028     GUI_DEBUG_PRINT( "PanelControl::Draw()\n");
00029     GraphicsDriver *pclDriver = GetParentWindow()->
      GetDriver();
00030     DrawRectangle_t stRectangle;
00031     K_USHORT usX, usY;
00032
00033     GetControlOffset(&usX, &usY);
00034
00035     stRectangle.usTop = GetTop() + usY;
00036     stRectangle.usBottom = stRectangle.usTop + GetHeight() -1;
00037     stRectangle.usLeft = GetLeft() + usX;
00038     stRectangle.usRight = stRectangle.usLeft + GetWidth() -1;
00039     stRectangle.bFill = true;
00040     stRectangle.uLineColor = m_uColor;
00041     stRectangle.uFillColor = m_uColor;
00042
00043     pclDriver->Rectangle(&stRectangle);
00044 }
```

14.29 /home/moslevin2/mark3/embedded/stage/src/control_panel.h File Reference

GUI Panel Control.

```
#include "gui.h"
#include "kerneltypes.h"
#include "draw.h"
```

Classes

- class PanelControl

14.29.1 Detailed Description

GUI Panel Control. The "panel" is probably the simplest control that can be implemented in a GUI. It serves as a dock for other controls, and also as an example for implementing more complex controls.

A panel is essentially a flat rectangle, specified by a control's typical top/left/height/width parameters, and a color value.

Definition in file control_panel.h.

14.30 control_panel.h

```
/*===========================================================================
     _____     _____     _____     _____
 ___|    _|__ __|_    |__ __|__   |__ __| __  |__  ______
|    \  /  | ||    \    ||     |     ||  |/ /    ||___   |
|     \/   | ||     \   ||     \     ||     \    ||___   |
|__/\__/|__|_||__|\__\ __||__|\__\ __||__|\__\ __||______|
    |_____|      |_____|     |_____|     |_____|

--[Mark3 Realtime Platform]--------------------------------------------------

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===========================================================================*/
#ifndef __CONTROL_PANEL_H__
#define __CONTROL_PANEL_H__

#include "gui.h"
#include "kerneltypes.h"
#include "draw.h"

class PanelControl : public GuiControl
{
public:
    virtual void Init() { m_uColor = COLOR_BLACK; SetAcceptFocus(false); }
    virtual void Draw();
    virtual GuiReturn_t ProcessEvent( GuiEvent_t *pstEvent_ ) {};
    virtual void Activate( bool bActivate_ ) {}

    void SetColor( COLOR eColor_ ) { m_uColor = eColor_; }

private:
    COLOR m_uColor;

};

#endif

```

14.31 /home/moslevin2/mark3/embedded/stage/src/control_progress.cpp File Reference

GUI Progress Bar Control.

```
#include "gui.h"
#include "kerneltypes.h"
#include "draw.h"
#include "control_progress.h"
```

14.31.1 Detailed Description

GUI Progress Bar Control. A simple progress bar control using lines and rectangles to display the status of an operation from initialization to completion

Definition in file control_progress.cpp.

14.32 control_progress.cpp

```
00001 /*============================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__   ___|_    |__   ___|__   |__   ___| __  |__   ______
00004 |    \  /  | ||    \       ||      |      ||  |/ /     ||___    |
00005 |     \/   | ||     \      ||      \      ||     \     ||___    |
00006 |__/\__/|__|_||__|\__\  ___||__|\__\  ___||__|\__\  ___||______|
00007     |_____|      |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ============================================================================*/
00021 #include "gui.h"
00022 #include "kerneltypes.h"
00023 #include "draw.h"
00024 #include "control_progress.h"
00025
00026 //---------------------------------------------------------------------------
00027 void ProgressControl::Init()
00028 {
00029     m_uBackColor = COLOR_BLACK;
00030     m_uBorderColor = COLOR_GREY75;
00031     m_uProgressColor = COLOR_GREEN;
00032     SetAcceptFocus(false);
00033 }
00034
00035 //---------------------------------------------------------------------------
00036 void ProgressControl::Draw()
00037 {
00038     GraphicsDriver *pclDriver = GetParentWindow()->
      GetDriver();
00039     DrawRectangle_t stRect;
00040     DrawLine_t stLine;
00041
00042     K_USHORT usX, usY;
00043     K_USHORT usProgressWidth;
00044
00045     GetControlOffset(&usX, &usY);
00046
00047     // Draw the outside of the progress bar region
00048     stLine.uColor = m_uBorderColor;
00049     stLine.usX1 = usX + GetLeft() + 1;
00050     stLine.usX2 = usX + GetLeft() + GetWidth() - 2;
00051     stLine.usY1 = usY + GetTop();
00052     stLine.usY2 = usY + GetTop();
00053     pclDriver->Line(&stLine);
00054
00055     stLine.usY1 = usY + GetTop() + GetHeight() - 1;
00056     stLine.usY2 = usY + GetTop() + GetHeight() - 1;
00057     pclDriver->Line(&stLine);
00058
00059     stLine.usY1 = usY + GetTop() + 1;
00060     stLine.usY2 = usY + GetTop() + GetHeight() - 2;
00061     stLine.usX1 = usX + GetLeft();
00062     stLine.usX2 = usX + GetLeft();
00063     pclDriver->Line(&stLine);
00064
00065     stLine.usX1 = usX + GetLeft() + GetWidth() - 1;
00066     stLine.usX2 = usX + GetLeft() + GetWidth() - 1;
00067     pclDriver->Line(&stLine);
00068
00069     // Draw the "completed" portion
00070     usProgressWidth = (K_USHORT)( ( ( ( (K_ULONG)m_ucProgress) * (GetWidth()-2) ) + 50 ) / 100);
00071     stRect.usTop = usY + GetTop() + 1;
00072     stRect.usBottom = usY + GetTop() + GetHeight() - 2;
00073     stRect.usLeft = usX + GetLeft() + 1;
00074     stRect.usRight = stRect.usLeft + usProgressWidth - 1;
00075     stRect.bFill = true;
00076     stRect.uLineColor = m_uProgressColor;
00077     stRect.uFillColor = m_uProgressColor;
00078     pclDriver->Rectangle(&stRect);
00079
00080     // Draw the "incomplete" portion
00081     stRect.usLeft = stRect.usRight + 1;
00082     stRect.usRight = usX + GetLeft() + GetWidth() - 2;
00083     stRect.bFill = true;
00084     stRect.uLineColor = m_uBackColor;
00085     stRect.uFillColor = m_uBackColor;
00086     pclDriver->Rectangle(&stRect);
00087
00088 }
00089
00090 //---------------------------------------------------------------------------
```

```
00091 void ProgressControl::SetProgress( K_UCHAR ucProgress_ )
00092 {
00093     m_ucProgress = ucProgress_;
00094     if (m_ucProgress > 100)
00095     {
00096         m_ucProgress;
00097     }
00098     SetStale();
00099 }
00100
00101 //---------------------------------------------------------------------------
00102 GuiReturn_t ProgressControl::ProcessEvent(
      GuiEvent_t *pstEvent_)
00103 {
00104     return GUI_EVENT_OK;
00105 }
```

14.33 /home/moslevin2/mark3/embedded/stage/src/control_progress.h File Reference

GUI Progress Bar Control.

```
#include "gui.h"
#include "kerneltypes.h"
#include "draw.h"
#include "font.h"
```

Classes

- class ProgressControl

14.33.1 Detailed Description

GUI Progress Bar Control. A simple progress bar control using lines and rectangles to display the status of an operation from initialization to completion

Definition in file control_progress.h.

14.34 control_progress.h

```
00001 /*===========================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__   ___|_    |__   ___|__   |__   ___| __   |__   ______
00004 |    \   /   | ||     \       ||      |      ||   |/ /      ||___    |
00005 |     \/    | ||      \      ||      \      ||      \      ||___    |
00006 |__/\__/|__|_||__|\__\   ___||__|\__\   ___||__|\__\   ___||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00022 #ifndef __CONTROL_PROGRESS_H__
00023 #define __CONTROL_PROGRESS_H__
00024
00025 #include "gui.h"
00026 #include "kerneltypes.h"
00027 #include "draw.h"
00028 #include "font.h"
00029
00030 class ProgressControl : public GuiControl
00031 {
00032 public:
00033     virtual void Init();
00034     virtual void Draw();
00035     virtual GuiReturn_t ProcessEvent( GuiEvent_t *pstEvent_ );
00036     virtual void Activate( bool bActivate_ ) {}
00037
```

```
00038     void SetBackColor( COLOR eColor_ )  { m_uBackColor = eColor_; }
00039     void SetProgressColor( COLOR eColor_ )  { m_uProgressColor = eColor_; }
00040     void SetBorderColor( COLOR eColor_ )    { m_uBorderColor = eColor_; }
00041
00042     void SetProgress( K_UCHAR ucProgress_ );
00043
00044 private:
00045     COLOR m_uBackColor;
00046     COLOR m_uProgressColor;
00047     COLOR m_uBorderColor;
00048     K_UCHAR m_ucProgress;
00049 };
00050
00051 #endif
00052
```

14.35 /home/moslevin2/mark3/embedded/stage/src/control_slickbutton.h File Reference

GUI Button Control, with a flare.

```
#include "gui.h"
#include "kerneltypes.h"
#include "draw.h"
#include "font.h"
```

Classes

- class SlickButtonControl

Typedefs

- typedef void(∗ **ButtonCallback**)(void ∗pvData_)

14.35.1 Detailed Description

GUI Button Control, with a flare. Basic pushbutton control with an up/down state, and Mark3 visual style

Definition in file control_slickbutton.h.

14.36 control_slickbutton.h

```
00001
00002 /*===========================================================================
00003      _____          _____          _____          _____
00004  ___|    _|__   ___|_    |__   ___|__   |__   ___| __   |__   ______
00005 |    \  /   | ||    \       ||      |     ||   |/ /     ||___    |
00006 |     \/    | ||     \      ||      \     ||     \      ||___    |
00007 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00008     |_____|       |_____|       |_____|       |_____|
00009
00010 --[Mark3 Realtime Platform]----------------------------------------------
00011
00012 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00013 See license.txt for more information
00014 ===========================================================================*/
00022 #ifndef __CONTROL_SLICKBUTTON_H__
00023 #define __CONTROL_SLICKBUTTON_H__
00024
00025 #include "gui.h"
00026 #include "kerneltypes.h"
00027 #include "draw.h"
00028 #include "font.h"
00029
00030 typedef void (*ButtonCallback)( void *pvData_ );
00031
```

```
00032 class SlickButtonControl : public GuiControl
00033 {
00034 public:
00035
00036     virtual void Init();
00037     virtual void Draw();
00038     virtual GuiReturn_t ProcessEvent( GuiEvent_t *pstEvent_ );
00039     virtual void Activate( bool bActivate_ );
00040
00041     void SetFont( Font_t *pstFont_ )        { m_pstFont = pstFont_; }
00042
00043     void SetCaption( const K_CHAR *szCaption_ )     { m_szCaption = szCaption_;}
00044
00045     void SetCallback( ButtonCallback pfCallback_, void *pvData_ )
00046         { m_pfCallback = pfCallback_; m_pvCallbackData = pvData_; }
00047 private:
00048
00049     const K_CHAR *m_szCaption;
00050     Font_t *m_pstFont;
00051     bool    m_bState;
00052     K_UCHAR m_ucTimeout;
00053
00054     void *m_pvCallbackData;
00055     ButtonCallback m_pfCallback;
00056 };
00057
00058
00059 #endif
00060
```

14.37 /home/moslevin2/mark3/embedded/stage/src/control_slickprogress.cpp File Reference

GUI Progress Bar Control, with flare.

```
#include "gui.h"
#include "kerneltypes.h"
#include "draw.h"
#include "control_slickprogress.h"
```

14.37.1 Detailed Description

GUI Progress Bar Control, with flare. A simple progress bar control using lines and rectangles to display the status of an operation from initialization to completion

Definition in file control_slickprogress.cpp.

14.38 control_slickprogress.cpp

```
00001 /*===========================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__   ___|_    |__   ___|__   |__   ___| __   |__   ______
00004 |    \   /   | ||     \       ||      |      ||   |/ /      ||___    |
00005 |     \/    | ||      \      ||      \      ||      \      ||___    |
00006 |__/\__/|__|_||__|\__\   ___||__|\__\   ___||__|\__\   ___||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00021 #include "gui.h"
00022 #include "kerneltypes.h"
00023 #include "draw.h"
00024 #include "control_slickprogress.h"
00025
00026 //---------------------------------------------------------------------------
00027 void SlickProgressControl::Init()
00028 {
```

```
00029     SetAcceptFocus(false);
00030 }
00031
00032 //---------------------------------------------------------------------------
00033 void SlickProgressControl::Draw()
00034 {
00035     GraphicsDriver *pclDriver = GetParentWindow()->
      GetDriver();
00036     DrawRectangle_t stRect;
00037     DrawLine_t stLine;
00038
00039     K_USHORT usX, usY;
00040     K_USHORT usProgressWidth;
00041
00042     GetControlOffset(&usX, &usY);
00043
00044     // Draw the outside of the progress bar region
00045     stLine.uColor = COLOR_GREY50;
00046     stLine.usX1 = usX + GetLeft() + 1;
00047     stLine.usX2 = usX + GetLeft() + GetWidth() - 2;
00048     stLine.usY1 = usY + GetTop();
00049     stLine.usY2 = usY + GetTop();
00050     pclDriver->Line(&stLine);
00051
00052     stLine.usY1 = usY + GetTop() + GetHeight() - 1;
00053     stLine.usY2 = usY + GetTop() + GetHeight() - 1;
00054     pclDriver->Line(&stLine);
00055
00056     stLine.usY1 = usY + GetTop() + 1;
00057     stLine.usY2 = usY + GetTop() + GetHeight() - 2;
00058     stLine.usX1 = usX + GetLeft();
00059     stLine.usX2 = usX + GetLeft();
00060     pclDriver->Line(&stLine);
00061
00062     stLine.usX1 = usX + GetLeft() + GetWidth() - 1;
00063     stLine.usX2 = usX + GetLeft() + GetWidth() - 1;
00064     pclDriver->Line(&stLine);
00065
00066     // Draw the "completed" portion
00067     usProgressWidth = (K_USHORT)( ( ( ( (K_ULONG)m_ucProgress) * (GetWidth()-2) ) + 50 ) / 100);
00068     stRect.usTop = usY + GetTop() + 1;
00069     stRect.usBottom = usY + GetTop() + ((GetHeight() - 1) / 2);
00070     stRect.usLeft = usX + GetLeft() + 1;
00071     stRect.usRight = stRect.usLeft + usProgressWidth - 1;
00072     stRect.bFill = true;
00073     stRect.uLineColor = RGB_COLOR( 0, (K_UCHAR)(MAX_GREEN * 0.85), (K_UCHAR)(MAX_BLUE * 0.25));
00074     stRect.uFillColor = stRect.uLineColor;
00075     pclDriver->Rectangle(&stRect);
00076
00077     stRect.usTop = stRect.usBottom + 1;
00078     stRect.usBottom = usY + GetTop() + GetHeight() - 2;
00079     stRect.uLineColor = RGB_COLOR( 0, (K_ULONG)(MAX_GREEN * 0.75), (K_ULONG)(MAX_BLUE * 0.20));
00080     stRect.uFillColor = stRect.uLineColor;
00081     pclDriver->Rectangle(&stRect);
00082
00083     // Draw the "incomplete" portion
00084     stRect.usTop = usY + GetTop() + 1;
00085     stRect.usBottom = usY + GetTop() + GetHeight() - 2;
00086     stRect.usLeft = stRect.usRight + 1;
00087     stRect.usRight = usX + GetLeft() + GetWidth() - 2;
00088     stRect.bFill = true;
00089     stRect.uLineColor = RGB_COLOR( (K_ULONG)(MAX_RED * 0.10), (K_ULONG)(MAX_GREEN * 0.10), (
      K_ULONG)(MAX_BLUE * 0.10));
00090     stRect.uFillColor = stRect.uLineColor;
00091     pclDriver->Rectangle(&stRect);
00092
00093 }
00094
00095 //---------------------------------------------------------------------------
00096 void SlickProgressControl::SetProgress( K_UCHAR ucProgress_ )
00097 {
00098     m_ucProgress = ucProgress_;
00099     if (m_ucProgress > 100)
00100     {
00101         m_ucProgress;
00102     }
00103     SetStale();
00104 }
00105
00106 //---------------------------------------------------------------------------
00107 GuiReturn_t SlickProgressControl::ProcessEvent(
      GuiEvent_t *pstEvent_)
00108 {
00109     return GUI_EVENT_OK;
00110 }
```

14.39 /home/moslevin2/mark3/embedded/stage/src/control_slickprogress.h File Reference

GUI Progress Bar Control, with flare.

```
#include "gui.h"
#include "kerneltypes.h"
#include "draw.h"
#include "font.h"
```

Classes

- class SlickProgressControl

14.39.1 Detailed Description

GUI Progress Bar Control, with flare. A simple progress bar control using lines and rectangles to display the status of an operation from initialization to completion

Definition in file control_slickprogress.h.

14.40 control_slickprogress.h

```
00001 /*=============================================================================
00002     _____       _____       _____       _____
00003  ___|    _|__  __|_    |__  __|__    |__  __| __  |__  _______
00004 |    \  /  | ||    \       ||     |     ||  |/ /     ||___    |
00005 |     \/   | ||     \      ||     \     ||     \     ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||_______|
00007    |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00022 #ifndef __CONTROL_SLICKPROGRESS_H__
00023 #define __CONTROL_SLICKPROGRESS_H__
00024
00025 #include "gui.h"
00026 #include "kerneltypes.h"
00027 #include "draw.h"
00028 #include "font.h"
00029
00030 class SlickProgressControl : public GuiControl
00031 {
00032 public:
00033     virtual void Init();
00034     virtual void Draw();
00035     virtual GuiReturn_t ProcessEvent( GuiEvent_t *pstEvent_ );
00036     virtual void Activate( bool bActivate_ ) {}
00037
00038     void SetProgress( K_UCHAR ucProgress_ );
00039
00040 private:
00041     K_UCHAR m_ucProgress;
00042 };
00043
00044 #endif
00045
```

14.41 /home/moslevin2/mark3/embedded/stage/src/dcpu.cpp File Reference

Portable DCPU-16 CPU emulator.

```
#include "dcpu.h"
#include "kerneltypes.h"
#include "ll.h"
```

Macros

- #define **CORE_DEBUG** 0
- #define **DBG_PRINT**(...)

Variables

- static const K_UCHAR aucBasicOpcodeCycles []

  Define the number of cycles that each "basic" opcode takes to execute.
- static const K_UCHAR aucExtendedOpcodeCycles []

  Define the number of cycles that each "extended" opcode takes to execute.

14.41.1 Detailed Description

Portable DCPU-16 CPU emulator. The DCPU-16 is the in-game CPU used in the upcoming game 0x10^c, from the creators of the wildly successful Minecraft. While the DCPU is supposed to be part of the game, it has serious potential for use in all sorts of embedded applications.

The fact that DCPU is a very lightweight VM to implement and contains built-in instructions for accessing hardware peripheras and handling external interrupts lends itself to being used on microcontrollers.

Unlike a lot of embedded CPUs, DCPU-16 assembly is extremely simple to learn, since it has a very limited number of opcodes (37), each of which provide the same register/memory addressing modes for all operands. There are also only 2 opcode formats which make interpreting opcodes very efficient.

The DCPU-16 is extended using a variable number of "external hardware devices" which communicate with the CPU core using interrupts. These devices are enumerated on startup, and since there is no defined format for how these devices work, we can hijack this interface to provide a way for the DCPU to access resources supplied by the OS (i.e Timers, Drivers), or the hardware directly. This also lends itself to inter-VM communications (multiple DCPUs communicating with eachother in different OS threads). There's an immense amount of flexibility here - applications from debugging to scripting to runtime-configuration are all easily supported by this machine.

But what is a platform without tools support? Fortunately, the hype around 0x10c is building - and a development community for this platform has grown immensely. There are a number of compilers, assemblers, and IDEs, many of which support virtualized hardware extensions. One of the compilers is a CLANG/LLVM backend, which should allow for very good C language support.

I had attempted to do something similar by creating a VM based on the 8051 (see the Funk51 project on sourceforge), but that project was at least four times as large - and the tools support was very spotty. There were C compilers, but there was a lot of shimming required to produce output that was suitable for the VM. Also, the lack of a native host interface (interrupts, hardware bus enumerations, etc.) forced a non-standard approach to triggering native methods by writing commands to a reserved chunk of memory and writing to a special "trigger" address to invoke the native system. Using a DCPU-16 based simulator addresses this in a nice, clean way by providing modern tools, and a VM infrastruture tailored to be interfaced with a host.

Regarding this version of the DCPU emulator - it's very simple to use. Program binaries are loaded into buffers in the host CPU's RAM, with the host also providing a separate buffer for DCPU RAM. The size of the DCPU RAM buffer will contain both the RAM area, as well as the program stack, so care must be taken to ensure that the stack doesn't overflow. The DCPU specification allows for 64K words (128KB) of RAM and ROM each, but this implementation allows us to tailor the CPU for more efficient or minimal environments.

In the future, this emulator will be extended to provide a mechanism to allow programs to be run out of flash, EEPROM, or other interfaces via the Mark3 Drivers API.

Once the program has been loaded into the host's address space, the DCPU class can be initialized.

```
// Use 16-bit words for 16-bit emulator.
K_USHORT ausRAM[ RAM_SIZE ];
K_USHORT ausROM[ ROM_SIZE ];
{
    class DCPU clMyDCPU;

    // Read program code into ausROM buffer here

    // Initialize the DCPU emulator
    clMyDCPU.Init( ausROM, RAM_SIZE, ausROM, ROM_SIZE );
}
```

Once the emulator has been initialized, the VM can be run one opcode at a time, as in the following example.

```
while(1)
{
    clMyCPU.RunOpcode();
}
```

To inspect the contents of the VM's registers, call the GetRegisters() method. This is useful for printing the CPU state on a regular basis, or using the PC value to determine when to end execution, or to provide an offset for disassembling the current opcode.

```
DCPU_Registers *pstRegisters;
pstRegisters = clMyCPU.GetRegisters();
```

Definition in file dcpu.cpp.

14.42 dcpu.cpp

```
00001 /*===========================================================================
00002      _____          _____          _____          _____
00003  ___|    _|__   __|_    |__   __|__   |__   __| __   |__   ______
00004 |    \  /   | ||    \       ||      |     ||  |/ /     ||___    |
00005 |     \/    | ||     \      ||      \     ||     \     ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00114 #include "dcpu.h"
00115 #include "kerneltypes.h"
00116 #include "ll.h"
00117
00118 #define CORE_DEBUG 0
00119
00120 //---------------------------------------------------------------------------
00121 #if CORE_DEBUG
00122   #define DBG_PRINT(...)        printf(__VA_ARGS__)
00123 #else
00124   #define DBG_PRINT(...)
00125 #endif
00126
00127 //---------------------------------------------------------------------------
00131 static const K_UCHAR aucBasicOpcodeCycles[] =
00132 {
00133     0,      // OP_NON_BASIC = 0
00134     1,      // OP_SET
00135     2,      // OP_ADD
00136     2,      // OP_SUB
00137     2,      // OP_MUL
00138     2,      // OP_MLI
00139     3,      // OP_DIV
00140     3,      // OP_DVI,
00141     3,      // OP_MOD,
00142     3,      // OP_MDI,
00143     1,      // OP_AND,
00144     1,      // OP_BOR,
00145     1,      // OP_XOR,
00146     1,      // OP_SHR,
00147     1,      // OP_ASR,
00148     1,      // OP_SHL,
00149     2,      // OP_IFB,
```

```
00150     2,      // OP_IFC,
00151     2,      // OP_IFE,
00152     2,      // OP_IFN,
00153     2,      // OP_IFG,
00154     2,      // OP_IFA,
00155     2,      // OP_IFL,
00156     2,      // OP_IFU,
00157     0,      // OP_18,
00158     0,      // OP_19,
00159     3,      // OP_ADX,
00160     3,      // OP_SBX,
00161     0,      // OP_1C,
00162     0,      // OP_1D,
00163     2,      // OP_STI,
00164     2,      // OP_STD
00165 };
00166
00167 //-----------------------------------------------------------------------------
00171 static const K_UCHAR aucExtendedOpcodeCycles[] =
00172 {
00173     0,  // "RESERVED",
00174     3,  // "JSR",
00175     0,  // "UNDEFINED"
00176     0,  // "UNDEFINED"
00177     0,  // "UNDEFINED"
00178     0,  // "UNDEFINED"
00179     0,  // "UNDEFINED"
00180     0,  // "UNDEFINED"
00181     4,  // "INT",
00182     1,  // "IAG",
00183     1,  // "IAS",
00184     3,  // "RFI",
00185     2,  // "IAQ",
00186     0,  // "UNDEFINED"
00187     0,  // "UNDEFINED"
00188     0,  // "UNDEFINED"
00189     2,  // "HWN",
00190     4,  // "HWQ",
00191     4,  // "HWI",
00192     0,  // "UNDEFINED"
00193     0,  // "UNDEFINED"
00194     0,  // "UNDEFINED"
00195     0,  // "UNDEFINED"
00196     0,  // "UNDEFINED"
00197     0,  // "UNDEFINED"
00198     0,  // "UNDEFINED"
00199     0,  // "UNDEFINED"
00200     0,  // "UNDEFINED"
00201     0,  // "UNDEFINED"
00202     0,  // "UNDEFINED"
00203     0,  // "UNDEFINED"
00204     0,  // "UNDEFINED"
00205 };
00206
00207 //-----------------------------------------------------------------------------
00208 void DCPU::SET()
00209 {
00210     DBG_PRINT("SET\n");
00211     *b = *a;
00212 }
00213
00214 //-----------------------------------------------------------------------------
00215 void DCPU::ADD()
00216 {
00217     K_ULONG ulTemp;
00218     DBG_PRINT("ADD\n");
00219
00220     ulTemp = (K_ULONG)*a + (K_ULONG)*b;
00221     if (ulTemp >= 65536)
00222     {
00223         m_stRegisters.EX = 0x0001;
00224     }
00225     else
00226     {
00227         m_stRegisters.EX = 0;
00228     }
00229
00230     *b = *b + *a;
00231 }
00232
00233 //-----------------------------------------------------------------------------
00234 void DCPU::SUB()
00235 {
00236     K_LONG lTemp;
00237     DBG_PRINT("SUB\n");
00238
00239     lTemp = (K_LONG)*b - (K_LONG)*a;
```

```
00240     if (lTemp < 0)
00241     {
00242         m_stRegisters.EX = 0xFFFF;
00243     }
00244     else
00245     {
00246         m_stRegisters.EX = 0;
00247     }
00248 
00249     *b = *b - *a;
00250 }
00251 
00252 //-----------------------------------------------------------------------------
00253 void DCPU::MUL()
00254 {
00255     K_ULONG ulTemp;
00256 
00257     DBG_PRINT("MUL\n");
00258     ulTemp = (((K_ULONG)*a * (K_ULONG)*b));
00259     m_stRegisters.EX = (K_USHORT)(ulTemp >> 16);
00260     *b = (K_USHORT)(ulTemp & 0x0000FFFF);
00261 }
00262 
00263 //-----------------------------------------------------------------------------
00264 void DCPU::MLI()
00265 {
00266     K_LONG lTemp;
00267 
00268     DBG_PRINT("MLI\n");
00269     lTemp = ((K_LONG)(*(K_SHORT*)a) * (K_LONG)(*(K_SHORT*)b));
00270     m_stRegisters.EX = (K_USHORT)(lTemp >> 16);
00271     *b = (K_USHORT)(lTemp & 0x0000FFFF);
00272 }
00273 
00274 //-----------------------------------------------------------------------------
00275 void DCPU::DIV()
00276 {
00277     K_USHORT usTemp;
00278 
00279     DBG_PRINT("DIV\n");
00280     if (*a == 0)
00281     {
00282         *b = 0;
00283         m_stRegisters.EX = 0;
00284     }
00285     else
00286     {
00287         usTemp = (K_USHORT)((((K_ULONG)*b) << 16) / (K_ULONG)*a);
00288         *b = *b / *a;
00289         m_stRegisters.EX = usTemp;
00290     }
00291 }
00292 
00293 //-----------------------------------------------------------------------------
00294 void DCPU::DVI()
00295 {
00296     K_USHORT usTemp;
00297 
00298     DBG_PRINT("DVI\n");
00299     if (*a == 0)
00300     {
00301         *b = 0;
00302         m_stRegisters.EX = 0;
00303     }
00304     else
00305     {
00306         usTemp = (K_USHORT)((((K_LONG)*((K_SHORT*)b)) << 16) / (K_LONG)(*(K_SHORT*)
      a));
00307         *b = (K_USHORT)(*(K_SHORT*)b / *(K_SHORT*)a);
00308         m_stRegisters.EX = usTemp;
00309 
00310     }
00311 }
00312 
00313 //-----------------------------------------------------------------------------
00314 void DCPU::MOD()
00315 {
00316     DBG_PRINT("MOD\n");
00317     if (*a == 0)
00318     {
00319         *b = 0;
00320     }
00321     else
00322     {
00323         *b = *b % *a;
00324     }
00325 }
```

```
00326
00327 //-----------------------------------------------------------------------------
00328 void DCPU::MDI()
00329 {
00330     DBG_PRINT("MDI\n");
00331     if (*b == 0)
00332     {
00333         *a = 0;
00334     }
00335     else
00336     {
00337         *b = (K_USHORT)(*((K_SHORT*)b) % *((K_SHORT*)a));
00338     }
00339 }
00340
00341 //-----------------------------------------------------------------------------
00342 void DCPU::AND()
00343 {
00344     DBG_PRINT("AND\n");
00345     *b = *b & *a;
00346 }
00347
00348 //-----------------------------------------------------------------------------
00349 void DCPU::BOR()
00350 {
00351     DBG_PRINT("BOR\n");
00352     *b = *b | *a;
00353 }
00354
00355 //-----------------------------------------------------------------------------
00356 void DCPU::XOR()
00357 {
00358     DBG_PRINT("XOR\n");
00359     *b = *b ^ *a;
00360 }
00361
00362 //-----------------------------------------------------------------------------
00363 void DCPU::SHR()
00364 {
00365     K_USHORT usTemp = (K_USHORT)((((K_ULONG)*b) << 16) >> (K_ULONG)*a);
00366
00367     DBG_PRINT("SHR\n");
00368     *b = *b >> *a;
00369     m_stRegisters.EX = usTemp;
00370 }
00371
00372 //-----------------------------------------------------------------------------
00373 void DCPU::ASR()
00374 {
00375     K_USHORT usTemp = (K_USHORT)((((K_LONG)*b) << 16) >> (K_LONG)*a);
00376
00377     DBG_PRINT("ASR\n");
00378     *b = (K_USHORT)(*(K_SHORT*)b >> *(K_SHORT*)a);
00379     m_stRegisters.EX = usTemp;
00380 }
00381 //-----------------------------------------------------------------------------
00382 void DCPU::SHL()
00383 {
00384     K_USHORT usTemp = (K_USHORT)((((K_ULONG)*b) << (K_ULONG)*a) >> 16);
00385
00386     DBG_PRINT("SHL\n");
00387     *b = *b << *a;
00388     m_stRegisters.EX = usTemp;
00389 }
00390
00391 //-----------------------------------------------------------------------------
00392 bool DCPU::IFB()
00393 {
00394     DBG_PRINT("IFB\n");
00395     if ((*b & *a) != 0)
00396     {
00397         return true;
00398     }
00399     return false;
00400 }
00401
00402 //-----------------------------------------------------------------------------
00403 bool DCPU::IFC()
00404 {
00405     DBG_PRINT("IFC\n");
00406     if ((*b & *a) == 0)
00407     {
00408         return true;
00409     }
00410     return false;
00411 }
00412
```

```
00413 //---------------------------------------------------------------------------
00414 bool DCPU::IFE()
00415 {
00416     DBG_PRINT("IFE\n");
00417     if (*b == *a)
00418     {
00419         return true;
00420     }
00421     return false;
00422 }
00423
00424 //---------------------------------------------------------------------------
00425 bool DCPU::IFN()
00426 {
00427     DBG_PRINT("IFN\n");
00428     if (*b != *a)
00429     {
00430         return true;
00431     }
00432     return false;
00433 }
00434
00435 //---------------------------------------------------------------------------
00436 bool DCPU::IFG()
00437 {
00438     DBG_PRINT("IFG\n");
00439     if (*b > *a)
00440     {
00441         return true;
00442     }
00443     return false;
00444 }
00445
00446 //---------------------------------------------------------------------------
00447 bool DCPU::IFA()
00448 {
00449     DBG_PRINT("IFA\n");
00450     if (*((K_SHORT*)b) > *((K_SHORT*)a))
00451     {
00452         return true;
00453     }
00454     return false;
00455 }
00456
00457 //---------------------------------------------------------------------------
00458 bool DCPU::IFL()
00459 {
00460     DBG_PRINT("IFL\n");
00461     if (*b < *a)
00462     {
00463         return true;
00464     }
00465     return false;
00466 }
00467
00468 //---------------------------------------------------------------------------
00469 bool DCPU::IFU()
00470 {
00471     DBG_PRINT("IFU\n");
00472     if (*(K_SHORT*)b < *(K_SHORT*)a)
00473     {
00474         return true;
00475     }
00476     return false;
00477 }
00478
00479 //---------------------------------------------------------------------------
00480 void DCPU::ADX()
00481 {
00482     K_ULONG ulTemp;
00483     DBG_PRINT("ADX\n");
00484     ulTemp = (K_ULONG)*b + (K_ULONG)*a + (K_ULONG)m_stRegisters.EX;
00485     if (ulTemp >= 0x10000)
00486     {
00487         m_stRegisters.EX = 1;
00488     }
00489     else
00490     {
00491         m_stRegisters.EX = 0;
00492     }
00493
00494     *b = ((K_USHORT)(ulTemp & 0x0000FFFF));
00495 }
00496
00497 //---------------------------------------------------------------------------
00498 void DCPU::SBX()
00499 {
```

```
00500     K_LONG lTemp;
00501     DBG_PRINT("SBX\n");
00502     lTemp = (K_LONG)*b - (K_LONG)*a + (K_LONG)m_stRegisters.EX;
00503     if (lTemp < 0 )
00504     {
00505         m_stRegisters.EX = 0xFFFF;
00506     }
00507     else
00508     {
00509         m_stRegisters.EX = 0;
00510     }
00511 
00512     *b = ((K_USHORT)(lTemp & 0x0000FFFF));
00513 }
00514 
00515 //-----------------------------------------------------------------------------
00516 void DCPU::STI()
00517 {
00518     DBG_PRINT("STI\n");
00519     *b = *a;
00520     m_stRegisters.I++;
00521     m_stRegisters.J++;
00522 }
00523 
00524 //-----------------------------------------------------------------------------
00525 void DCPU::STD()
00526 {
00527     DBG_PRINT("STD\n");
00528     *b = *a;
00529     m_stRegisters.I--;
00530     m_stRegisters.J--;
00531 }
00532 
00533 //-----------------------------------------------------------------------------
00534 void DCPU::JSR()
00535 {
00536     DBG_PRINT("JSR\n");
00537     m_pusRAM[ --m_stRegisters.SP ] = m_stRegisters.PC;
00538     m_stRegisters.PC = *b;
00539 }
00540 
00541 //-----------------------------------------------------------------------------
00542 void DCPU::INT()
00543 {
00544     DBG_PRINT("INT\n");
00545 
00546     if (m_stRegisters.IA == 0)
00547     {
00548         // If IA is not set, return out.
00549         return;
00550     }
00551 
00552     // Either acknowledge the interrupt immediately, or queue it.
00553     if (m_bInterruptQueueing == false)
00554     {
00555         m_pusRAM[ --m_stRegisters.SP ] = m_stRegisters.PC;
00556         m_pusRAM[ --m_stRegisters.SP ] = m_stRegisters.A;
00557 
00558         m_stRegisters.A = *a;
00559         m_stRegisters.PC = m_stRegisters.IA;
00560         m_bInterruptQueueing = true;
00561     }
00562     else
00563     {
00564         // Add interrupt message to the queue
00565         m_ausInterruptQueue[ ++m_ucQueueLevel ] = *
      a;
00566     }
00567 }
00568 
00569 //-----------------------------------------------------------------------------
00570 void DCPU::ProcessInterruptQueue()
00571 {
00572     // If there's an interrupt address specified, queueing is disabled, and
00573     // the queue isn't empty
00574     if (m_stRegisters.IA && !m_bInterruptQueueing &&
      m_ucQueueLevel)
00575     {
00576         m_pusRAM[ --m_stRegisters.SP ] = m_stRegisters.PC;
00577         m_pusRAM[ --m_stRegisters.SP ] = m_stRegisters.A;
00578 
00579         m_stRegisters.A = m_ausInterruptQueue[
      m_ucQueueLevel-- ];
00580         m_stRegisters.PC = m_stRegisters.IA;
00581 
00582         m_bInterruptQueueing = true;
00583     }
```

```
00584 }
00585
00586
00587 //---------------------------------------------------------------------------
00588 void DCPU::IAG()
00589 {
00590     DBG_PRINT("IAG\n");
00591
00592     *a = m_stRegisters.IA;
00593 }
00594
00595 //---------------------------------------------------------------------------
00596 void DCPU::IAS()
00597 {
00598     DBG_PRINT("IAS\n");
00599
00600     m_stRegisters.IA = *a;
00601 }
00602
00603 //---------------------------------------------------------------------------
00604 void DCPU::RFI()
00605 {
00606     DBG_PRINT("RFI\n");
00607
00611     m_bInterruptQueueing = false;
00612
00613     m_stRegisters.A  = m_pusRAM[ m_stRegisters.SP++ ];
00614     m_stRegisters.PC = m_pusRAM[ m_stRegisters.SP++ ];
00615
00616 }
00617
00618 //---------------------------------------------------------------------------
00619 void DCPU::IAQ()
00620 {
00621     DBG_PRINT("IAQ\n");
00622
00626     if (*a)
00627     {
00628         m_bInterruptQueueing = true;
00629     }
00630     else
00631     {
00632         m_bInterruptQueueing = false;
00633     }
00634 }
00635
00636 //---------------------------------------------------------------------------
00637 void DCPU::HWN()
00638 {
00639     LinkListNode *pclNode;
00640
00641     DBG_PRINT("HWN\n");
00642     m_usTempA = 0;
00644     pclNode = m_clPluginList.GetHead();
00645     while (pclNode)
00646     {
00647         m_usTempA++;
00648         pclNode = pclNode->GetNext();
00649     }
00650
00651     *a = m_usTempA;
00652 }
00653
00654 //---------------------------------------------------------------------------
00655 void DCPU::HWQ()
00656 {
00657     DBG_PRINT("HWQ\n");
00658     DCPUPlugin *pclPlugin;
00659     pclPlugin = (DCPUPlugin*)m_clPluginList.GetHead();
00660
00661     while (pclPlugin)
00662     {
00663         if (pclPlugin->GetDeviceNumber() == *a)
00664         {
00665             pclPlugin->Enumerate(&m_stRegisters);
00666             break;
00667         }
00668         pclPlugin = (DCPUPlugin*)pclPlugin->GetNext();
00669     }
00670 }
00671
00672 //---------------------------------------------------------------------------
00673 void DCPU::HWI()
00674 {
00675     DBG_PRINT("HWI\n");
00676
00677     DCPUPlugin *pclPlugin;
```

```
00678     pclPlugin = (DCPUPlugin*)m_clPluginList.GetHead();
00679
00680     while (pclPlugin)
00681     {
00682         if (pclPlugin->GetDeviceNumber() == *a)
00683         {
00684             pclPlugin->Interrupt(this);
00685             break;
00686         }
00687         pclPlugin = (DCPUPlugin*)pclPlugin->GetNext();
00688     }
00689 }
00690
00691 //----------------------------------------------------------------------------
00692 void DCPU::Init(  K_USHORT *pusRAM_, K_USHORT usRAMSize_,
00693                   const K_USHORT *pusROM_, K_USHORT usROMSize_ )
00694 {
00695     m_stRegisters.PC = 0;
00696     m_stRegisters.SP = usRAMSize_ ;
00697     m_stRegisters.A = 0;
00698     m_stRegisters.B = 0;
00699     m_stRegisters.C = 0;
00700     m_stRegisters.X = 0;
00701     m_stRegisters.Y = 0;
00702     m_stRegisters.Z = 0;
00703     m_stRegisters.I = 0;
00704     m_stRegisters.J = 0;
00705     m_stRegisters.EX = 0;
00706     m_stRegisters.IA = 0;
00707     m_ulCycleCount = 0;
00708
00709     m_pusROM = (K_USHORT*)pusROM_;
00710     m_usROMSize = usROMSize_;
00711
00712     m_pusRAM = pusRAM_;
00713     m_usRAMSize = usRAMSize_;
00714 }
00715
00716 //----------------------------------------------------------------------------
00717 K_UCHAR DCPU::GetOperand( K_UCHAR ucOpType_, K_USHORT **pusResult_ )
00718 {
00719     K_UCHAR ucRetVal = 0;
00720     switch (ucOpType_)
00721     {
00722         case ARG_A: case ARG_B: case ARG_C: case ARG_X:
00723         case ARG_Y: case ARG_Z: case ARG_I: case ARG_J:
00724             *pusResult_ = &m_stRegisters.ausRegisters[ ucOpType_ - ARG_A ];
00725             break;
00726
00727         case ARG_BRACKET_A: case ARG_BRACKET_B: case ARG_BRACKET_C: case ARG_BRACKET_X:
00728         case ARG_BRACKET_Y: case ARG_BRACKET_Z: case ARG_BRACKET_I: case ARG_BRACKET_J:
00729             *pusResult_ = &m_pusRAM[ m_stRegisters.ausRegisters[ ucOpType_ -
    ARG_BRACKET_A ] ];
00730             break;
00731
00732         case ARG_WORD_A: case ARG_WORD_B: case ARG_WORD_C: case ARG_WORD_X:
00733         case ARG_WORD_Y: case ARG_WORD_Z: case ARG_WORD_I: case ARG_WORD_J:
00734         {
00735             K_USHORT usTemp = m_pusROM[ m_stRegisters.PC++ ];
00736             usTemp += m_stRegisters.ausRegisters[ ucOpType_ - ARG_WORD_A ];
00737             *pusResult_ = &m_pusRAM[ usTemp ];
00738             ucRetVal = 1;
00739         }
00740             break;
00741         case ARG_PUSH_POP_SP:
00742             if (*pusResult_ == a)
00743             {
00744                 a = &m_pusRAM[ m_stRegisters.SP++ ];
00745             }
00746             else
00747             {
00748                 b = &m_pusRAM[ --m_stRegisters.SP ];
00749             }
00750             break;
00751         case ARG_PEEK_SP:
00752             *pusResult_ = &m_pusRAM[ m_stRegisters.SP ];
00753             break;
00754         case ARG_WORD_SP:
00755         {
00756             K_USHORT usTemp = m_pusROM[ m_stRegisters.PC++ ];
00757             usTemp += m_stRegisters.SP;
00758             *pusResult_ = &m_pusRAM[ usTemp ];
00759             ucRetVal++;
00760         }
00761             break;
00762         case ARG_SP:
00763             *pusResult_ = &(m_stRegisters.SP);
```

```
00764             break;
00765         case ARG_PC:
00766             *pusResult_ = &(m_stRegisters.PC);
00767             break;
00768         case ARG_EX:
00769             *pusResult_ = &(m_stRegisters.EX);
00770             break;
00771         case ARG_NEXT_WORD:
00772             *pusResult_ = &m_pusRAM[ m_pusROM[ m_stRegisters.PC++ ] ];
00773             ucRetVal++;
00774             break;
00775         case ARG_NEXT_LITERAL:
00776             *pusResult_ = &m_pusROM[ m_stRegisters.PC++ ];
00777             ucRetVal++;
00778             break;
00779 
00780         case ARG_LITERAL_0:
00781             *pusResult_ = &m_usTempA;
00782             m_usTempA = (K_USHORT)(-1);
00783             break;
00784         case ARG_LITERAL_1: case ARG_LITERAL_2: case ARG_LITERAL_3: case ARG_LITERAL_4:
00785         case ARG_LITERAL_5: case ARG_LITERAL_6: case ARG_LITERAL_7: case ARG_LITERAL_8:
00786         case ARG_LITERAL_9: case ARG_LITERAL_A: case ARG_LITERAL_B: case ARG_LITERAL_C:
00787         case ARG_LITERAL_D: case ARG_LITERAL_E: case ARG_LITERAL_F: case ARG_LITERAL_10:
00788         case ARG_LITERAL_11: case ARG_LITERAL_12: case ARG_LITERAL_13: case ARG_LITERAL_14:
00789         case ARG_LITERAL_15: case ARG_LITERAL_16: case ARG_LITERAL_17: case ARG_LITERAL_18:
00790         case ARG_LITERAL_19: case ARG_LITERAL_1A: case ARG_LITERAL_1B: case ARG_LITERAL_1C:
00791         case ARG_LITERAL_1D: case ARG_LITERAL_1E: case ARG_LITERAL_1F:
00792             *pusResult_ = &m_usTempA;
00793             m_usTempA = (K_USHORT)(ucOpType_ - ARG_LITERAL_1);
00794             break;
00795         default:
00796             break;
00797     }
00798     return ucRetVal;
00799 }
00800 
00801 //---------------------------------------------------------------------------
00802 void DCPU::RunOpcode()
00803 {
00804     // Fetch the opcode @ the current program counter
00805     K_USHORT usWord = m_pusROM[ m_stRegisters.PC++ ];
00806     K_UCHAR ucOp = (K_UCHAR)DCPU_NORMAL_OPCODE_MASK(usWord);
00807     K_UCHAR ucA = (K_UCHAR)DCPU_A_MASK(usWord);
00808     K_UCHAR ucB = (K_UCHAR)DCPU_B_MASK(usWord);
00809     K_UCHAR ucSize = 1;
00810 
00811     // Decode the opcode
00812     if (ucOp)
00813     {
00814         bool bRunNext = true;
00815 
00816         a = &m_usTempA;
00817         b = 0;
00818 
00819         // If this is a "basic" opcode, decode "a" and "b"
00820         ucSize += GetOperand( ucA , &a );
00821         ucSize += GetOperand( ucB, &b );
00822 
00823         // Add the cycles to the runtime clock
00824         m_ulCycleCount += (K_ULONG)aucBasicOpcodeCycles[ ucOp ];
00825         m_ulCycleCount += (ucSize - 1);
00826 
00827         // Execute the instruction once we've decoded the opcode and
00828         // processed the arguments.
00829         switch (DCPU_NORMAL_OPCODE_MASK(usWord))
00830         {
00831             case OP_SET:  SET();      break;
00832             case OP_ADD:  ADD();      break;
00833             case OP_SUB:  SUB();      break;
00834             case OP_MUL:  MUL();      break;
00835             case OP_MLI:  MLI();      break;
00836             case OP_DIV:  DIV();      break;
00837             case OP_DVI:  DVI();      break;
00838             case OP_MOD:  MOD();      break;
00839             case OP_MDI:  MDI();      break;
00840             case OP_AND:  AND();      break;
00841             case OP_BOR:  BOR();      break;
00842             case OP_XOR:  XOR();      break;
00843             case OP_SHR:  SHR();      break;
00844             case OP_ASR:  ASR();      break;
00845             case OP_SHL:  SHL();      break;
00846             case OP_IFB:  bRunNext = IFB();   break;
00847             case OP_IFC:  bRunNext = IFC();   break;
00848             case OP_IFE:  bRunNext = IFE();   break;
00849             case OP_IFN:  bRunNext = IFN();   break;
00850             case OP_IFG:  bRunNext = IFG();   break;
```

```
00851             case OP_IFA:  bRunNext = IFA();   break;
00852             case OP_IFL:  bRunNext = IFL();   break;
00853             case OP_IFU:  bRunNext = IFU();   break;
00854             case OP_ADX:  ADX();      break;
00855             case OP_SBX:  SBX();      break;
00856             case OP_STI:  STI();      break;
00857             case OP_STD:  STD();      break;
00858             default:    break;
00859         }
00860 
00861         // If we're not supposed to run the next instruction (i.e. skip it
00862         // due to failed condition), adjust the PC.
00863         if (!bRunNext)
00864         {
00865             // Skipped branches take an extra cycle
00866             m_ulCycleCount++;
00867 
00868             // Skip the next opcode
00869             usWord = m_pusROM[ m_stRegisters.PC++ ];
00870             if (DCPU_NORMAL_OPCODE_MASK(usWord))
00871             {
00872                 DBG_PRINT( "Skipping Basic Opcode: %X\n",
      DCPU_NORMAL_OPCODE_MASK(usWord));
00873                 // If this is a "basic" opcode, decode "a" and "b" - we do this to make sure our
00874                 // PC gets adjusted properly.
00875                 GetOperand( DCPU_A_MASK(usWord), &a );
00876                 GetOperand( DCPU_B_MASK(usWord), &b );
00877             }
00878             else
00879             {
00880                 DBG_PRINT( "Skipping Extended Opcode: %X\n", DCPU_EXTENDED_OPCODE_MASK(usWord));
00881                 GetOperand( DCPU_A_MASK(usWord), &a );
00882             }
00883         }
00884     }
00885     else
00886     {
00887         // Extended opcode.  These only have a single argument, stored in the
00888         // "a" field.
00889         GetOperand( ucA, &a );
00890         m_ulCycleCount++;
00891 
00892         // Execute the "extended" instruction now that the opcode has been
00893         // decoded, and the arguments processed.
00894         switch (ucB)
00895         {
00896             case OP_EX_JSR:    JSR();  break;
00897             case OP_EX_INT:        INT();  break;
00898             case OP_EX_IAG:        IAG();  break;
00899             case OP_EX_IAS:        IAS();  break;
00900             case OP_EX_RFI:        RFI();  break;
00901             case OP_EX_IAQ:        IAQ();   break;
00902             case OP_EX_HWN:        HWN();   break;
00903             case OP_EX_HWQ:        HWQ();  break;
00904             case OP_EX_HWI:        HWI();  break;
00905             default:    break;
00906         }
00907     }
00908 
00909     // Process an interrupt from the queue (if there is one)
00910     ProcessInterruptQueue();
00911 }
00912 
00913 //-----------------------------------------------------------------------------
00914 void DCPU::SendInterrupt( K_USHORT usMessage_ )
00915 {
00916     if (m_stRegisters.IA == 0)
00917     {
00918         // If IA is not set, return out.
00919         return;
00920     }
00921 
00922     // Either acknowledge the interrupt immediately, or queue it.
00923     if (m_bInterruptQueueing == false)
00924     {
00925         m_pusRAM[ --m_stRegisters.SP ] = m_stRegisters.PC;
00926         m_pusRAM[ --m_stRegisters.SP ] = m_stRegisters.A;
00927 
00928         m_stRegisters.A = usMessage_;
00929         m_stRegisters.PC = m_stRegisters.IA;
00930         m_bInterruptQueueing = true;
00931     }
00932     else
00933     {
00934         // Add interrupt message to the queue
00935         m_ausInterruptQueue[ ++m_ucQueueLevel ] = usMessage_;
00936     }
```

```
00937 }
00938
00939 //---------------------------------------------------------------------------
00940 void DCPU::AddPlugin( DCPUPlugin *pclPlugin_ )
00941 {
00942     m_clPluginList.Add( (LinkListNode*)pclPlugin_ );
00943 }
```

14.43 /home/moslevin2/mark3/embedded/stage/src/dcpu.h File Reference

DCPU-16 emulator.

```
#include "kerneltypes.h"
#include "ll.h"
```

Classes

- struct DCPU_Registers

  Structure defining the DCPU hardware registers.
- class DCPUPlugin

  Class used to provide the hardware device abstraction between the DCPU-16 emulator/VM and the host system.
- class DCPU

  DCPU emulator, used for running code out of EEPROM, RAM, or other memory interfaces than FLASH.

Macros

- #define DCPU_NORMAL_OPCODE_MASK(x) ((K_USHORT)(x & 0x001F))

  DCPU v1.7 CPU emulator.
- #define **DCPU_EXTENDED_OPCODE_MASK**(x) ((K_USHORT)((x >> 5) & 0x001F))
- #define **DCPU_A_MASK**(x) ((K_USHORT)((x >> 10) & 0x003F))
- #define **DCPU_B_MASK**(x) ((K_USHORT)((x >> 5) & 0x001F))
- #define **DCPU_BUILD_NORMAL**(x, y, z) (((K_USHORT)(x) & 0x001F) | ((K_USHORT)(y) & 0x001F) << 5 | ((K_USHORT)(z) & 0x003F) << 10)
- #define **DCPU_BUILD_EXTENDED**(x, y) (((K_USHORT)(x & 0x001F) << 5) | ((K_USHORT)(y & 0x003F) << 10))

Typedefs

- typedef void(* DCPU_Callback)(DCPU *pclVM_)

  Callback function type used to implement HWI for VM->Host communications.

Enumerations

- enum DCPU_OpBasic {
  OP_NON_BASIC = 0, OP_SET, OP_ADD, OP_SUB,
  OP_MUL, OP_MLI, OP_DIV, OP_DVI,
  OP_MOD, OP_MDI, OP_AND, OP_BOR,
  OP_XOR, OP_SHR, OP_ASR, OP_SHL,
  OP_IFB, OP_IFC, OP_IFE, OP_IFN,
  OP_IFG, OP_IFA, OP_IFL, OP_IFU,
  OP_18, OP_19, OP_ADX, OP_SBX,
  OP_1C, OP_1D, OP_STI, OP_STD }

  DCPU Basic Opcodes.

- enum DCPU_OpExtended {
  OP_EX_RESERVED = 0, OP_EX_JSR, OP_EX_2, OP_EX_3,
  OP_EX_4, OP_EX_5, OP_EX_6, OP_EX_7,
  OP_EX_INT, OP_EX_IAG, OP_EX_IAS, OP_EX_RFI,
  OP_EX_IAQ, OP_EX_D, OP_EX_E, OP_EX_F,
  OP_EX_HWN, OP_EX_HWQ, OP_EX_HWI, OP_EX_13,
  OP_EX_14, OP_EX_15, OP_EX_16, OP_EX_17,
  OP_EX_18, OP_EX_19, OP_EX_1A, OP_EX_1B,
  OP_EX_1C, OP_EX_1D, OP_EX_1E, OP_EX_1F }

  DCPU Extended opcodes.
- enum DCPU_Argument {
  ARG_A = 0, **ARG_B**, **ARG_C**, **ARG_X**,
  ARG_Y, **ARG_Z**, **ARG_I**, **ARG_J**,
  ARG_BRACKET_A, **ARG_BRACKET_B**, **ARG_BRACKET_C**, **ARG_BRACKET_X**,
  ARG_BRACKET_Y, **ARG_BRACKET_Z**, **ARG_BRACKET_I**, **ARG_BRACKET_J**,
  ARG_WORD_A, **ARG_WORD_B**, **ARG_WORD_C**, **ARG_WORD_X**,
  ARG_WORD_Y, **ARG_WORD_Z**, **ARG_WORD_I**, **ARG_WORD_J**,
  ARG_PUSH_POP_SP, **ARG_PEEK_SP**, **ARG_WORD_SP**, **ARG_SP**,
  ARG_PC, **ARG_EX**, **ARG_NEXT_WORD**, **ARG_NEXT_LITERAL**,
  ARG_LITERAL_0, **ARG_LITERAL_1**, **ARG_LITERAL_2**, **ARG_LITERAL_3**,
  ARG_LITERAL_4, **ARG_LITERAL_5**, **ARG_LITERAL_6**, **ARG_LITERAL_7**,
  ARG_LITERAL_8, **ARG_LITERAL_9**, **ARG_LITERAL_A**, **ARG_LITERAL_B**,
  ARG_LITERAL_C, **ARG_LITERAL_D**, **ARG_LITERAL_E**, **ARG_LITERAL_F**,
  ARG_LITERAL_10, **ARG_LITERAL_11**, **ARG_LITERAL_12**, **ARG_LITERAL_13**,
  ARG_LITERAL_14, **ARG_LITERAL_15**, **ARG_LITERAL_16**, **ARG_LITERAL_17**,
  ARG_LITERAL_18, **ARG_LITERAL_19**, **ARG_LITERAL_1A**, **ARG_LITERAL_1B**,
  ARG_LITERAL_1C, **ARG_LITERAL_1D**, **ARG_LITERAL_1E**, **ARG_LITERAL_1F** }

  Argument formats.

14.43.1 Detailed Description

DCPU-16 emulator.

Definition in file dcpu.h.

14.43.2 Macro Definition Documentation

14.43.2.1 #define DCPU_NORMAL_OPCODE_MASK(*x*) ((K_USHORT)(x & 0x001F))

DCPU v1.7 CPU emulator.

Basic opcode format: [aaaaaabbbbbooooo]

Where: - aaaaaa 6-bit source argument

- bbbbb 5-bit destination argument
- o is the opcode itself in a

If oooo = 0, then it's an "extended" opcode

Extended opcode format: [aaaaaaooooooxxxxx]

Where:

- xxxxx = all 0's - (basic opcode)
- ooooo = an extended opcode
- aaaaaa = the argument

Definition at line 48 of file dcpu.h.

14.43.3 Enumeration Type Documentation

14.43.3.1 enum DCPU_OpBasic

DCPU Basic Opcodes.

Enumerator

OP_NON_BASIC special instruction - see below

OP_SET b, a | sets b to a

OP_ADD b, a | sets b to b+a, sets EX to 0x0001 if there's an overflow, 0x0 otherwise

OP_SUB b, a | sets b to b-a, sets EX to 0xffff if there's an underflow, 0x0 otherwise

OP_MUL b, a | sets b to b*a, sets EX to ((b*a)>>16)&0xffff (treats b, a as unsigned)

OP_MLI b, a | like MUL, but treat b, a as signed

OP_DIV b, a | sets b to b/a, sets EX to ((b<<16)/a)&0xffff. if a==0, sets b and EX to 0 instead. (treats b, a as unsigned)

OP_DVI b, a | like DIV, but treat b, a as signed. Rounds towards 0

OP_MOD b, a | sets b to ba. if a==0, sets b to 0 instead.

OP_MDI b, a | like MOD, but treat b, a as signed. (MDI -7, 16 == -7)

OP_AND b, a | sets b to b&a

OP_BOR b, a | sets b to b|a

OP_XOR b, a | sets b to b^a

OP_SHR b, a | sets b to b>>>a, sets EX to ((b<<16)>>a)&0xffff (logical shift)

OP_ASR b, a | sets b to b>>a, sets EX to ((b<<16)>>>a)&0xffff (arithmetic shift) (treats b as signed)

OP_SHL b, a | sets b to b<<a, sets EX to ((b<<a)>>16)&0xffff

OP_IFB b, a | performs next instruction only if (b&a)!=0

OP_IFC b, a | performs next instruction only if (b&a)==0

OP_IFE b, a | performs next instruction only if b==a

OP_IFN b, a | performs next instruction only if b!=a

OP_IFG b, a | performs next instruction only if b>a

OP_IFA b, a | performs next instruction only if b>a (signed)

OP_IFL b, a | performs next instruction only if b<a

OP_IFU b, a | performs next instruction only if b<a (signed)

OP_18 **UNDEFINED**

OP_19 **UNDEFINED**

OP_ADX b, a | sets b to b+a+EX, sets EX to 0x0001 if there is an over-flow, 0x0 otherwise

OP_SBX b, a | sets b to b-a+EX, sets EX to 0xFFFF if there is an under-flow, 0x0 otherwise

OP_1C **UNDEFINED**

OP_1D **UNDEFINED**

OP_STI b, a | sets b to a, then increases I and J by 1

OP_STD b, a | sets b to a, then decreases I and J by 1

Definition at line 99 of file dcpu.h.

14.43.3.2 enum DCPU_OpExtended

DCPU Extended opcodes.

Enumerator

OP_EX_JSR a - pushes the address of the next instruction to the stack, then sets PC to a

OP_EX_2 **UNDEFINED**

OP_EX_3 **UNDEFINED**

OP_EX_4 **UNDEFINED**

OP_EX_5 **UNDEFINED**

OP_EX_6 **UNDEFINED**

OP_EX_7 **UNDEFINED**

OP_EX_INT Invoke software interrupt "a".

OP_EX_IAG Get interrupt address in "a".

OP_EX_IAS Set interrupt address from "a".

OP_EX_RFI Disables interrupt queueing, pops A from the stack, then pops PC from the stack.

OP_EX_IAQ if a is nonzero, interrupts will be added to the queue instead of triggered. if a is zero, interrupts will be triggered as normal again

OP_EX_D **UNDEFINED**

OP_EX_E **UNDEFINED**

OP_EX_F **UNDEFINED**

OP_EX_HWN Sets "a" to number of connected HW devices.

OP_EX_HWQ Set registers with information about hardware at index "a".

OP_EX_HWI Send an interrupt to hardware interface "a".

OP_EX_13 **UNDEFINED**

OP_EX_14 **UNDEFINED**

OP_EX_15 **UNDEFINED**

OP_EX_16 **UNDEFINED**

OP_EX_17 **UNDEFINED**

OP_EX_18 **UNDEFINED**

OP_EX_19 **UNDEFINED**

OP_EX_1A **UNDEFINED**

OP_EX_1B **UNDEFINED**

OP_EX_1C **UNDEFINED**

OP_EX_1D **UNDEFINED**

OP_EX_1E **UNDEFINED**

OP_EX_1F **UNDEFINED**

Definition at line 139 of file dcpu.h.

14.44 dcpu.h

```
/*===========================================================================
     _____        _____        _____        _____
 ___|    _|__  __|_    |__  __|__   |__  __| __  |__  ______
|    \  /  | ||    \      ||     |     ||  |/ /    ||___   |
|     \/   | ||     \     ||     \     ||     \    ||___   |
|__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\ __||______|
    |_____|      |_____|      |_____|      |_____|
```

```
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00018 #ifndef __DCPU_H__
00019 #define __DCPU_H__
00020
00021 #include "kerneltypes.h"
00022 #include "ll.h"
00023
00024 //---------------------------------------------------------------------------
00046 //---------------------------------------------------------------------------
00047 // Macros to access individual elements from within an opcode
00048 #define DCPU_NORMAL_OPCODE_MASK( x ) \
00049         ((K_USHORT)(x & 0x001F))
00050
00051 #define DCPU_EXTENDED_OPCODE_MASK( x ) \
00052         ((K_USHORT)((x >> 5) & 0x001F))
00053
00054 #define DCPU_A_MASK( x ) \
00055         ((K_USHORT)((x >> 10) & 0x003F))
00056
00057 #define DCPU_B_MASK( x ) \
00058         ((K_USHORT)((x >> 5) & 0x001F))
00059
00060 //---------------------------------------------------------------------------
00061 // Macros to emit opcodes in the normal/extended formats
00062 #define DCPU_BUILD_NORMAL( x, y, z ) \
00063         ( ((K_USHORT)(x) & 0x001F) | ((K_USHORT)(y) & 0x001F) << 5 | ((K_USHORT)(z) & 0x003F) << 10 )
00064
00065 #define DCPU_BUILD_EXTENDED( x, y ) \
00066         ( ((K_USHORT)(x & 0x001F) << 5) | ((K_USHORT)(y & 0x003F) << 10) )
00067
00068 //---------------------------------------------------------------------------
00072 typedef struct
00073 {
00074     union
00075     {
00076         struct
00077         {
00078             K_USHORT A;
00079             K_USHORT B;
00080             K_USHORT C;
00081             K_USHORT X;
00082             K_USHORT Y;
00083             K_USHORT Z;
00084             K_USHORT I;
00085             K_USHORT J;
00086             K_USHORT PC;
00087             K_USHORT SP;
00088             K_USHORT EX;
00089             K_USHORT IA;
00090         };
00091         K_USHORT ausRegisters[12];
00092     };
00093 } DCPU_Registers;
00094
00095 //---------------------------------------------------------------------------
00099 typedef enum
00100 {
00101     OP_NON_BASIC = 0,
00102     OP_SET,
00103     OP_ADD,
00104     OP_SUB,
00105     OP_MUL,
00106     OP_MLI,
00107     OP_DIV,
00108     OP_DVI,
00109     OP_MOD,
00110     OP_MDI,
00111     OP_AND,
00112     OP_BOR,
00113     OP_XOR,
00114     OP_SHR,
00115     OP_ASR,
00116     OP_SHL,
00117     OP_IFB,
00118     OP_IFC,
00119     OP_IFE,
00120     OP_IFN,
00121     OP_IFG,
00122     OP_IFA,
00123     OP_IFL,
00124     OP_IFU,
00125     OP_18,
```

```
00126     OP_19,
00127     OP_ADX,
00128     OP_SBX,
00129     OP_1C,
00130     OP_1D,
00131     OP_STI,
00132     OP_STD
00133 } DCPU_OpBasic;
00134
00135 //-----------------------------------------------------------------------------
00139 typedef enum
00140 {
00141     OP_EX_RESERVED = 0,
00142     OP_EX_JSR,
00143     OP_EX_2,
00144     OP_EX_3,
00145     OP_EX_4,
00146     OP_EX_5,
00147     OP_EX_6,
00148     OP_EX_7,
00149     OP_EX_INT,
00150     OP_EX_IAG,
00151     OP_EX_IAS,
00152     OP_EX_RFI,
00153     OP_EX_IAQ,
00154     OP_EX_D,
00155     OP_EX_E,
00156     OP_EX_F,
00157     OP_EX_HWN,
00158     OP_EX_HWQ,
00159     OP_EX_HWI,
00160     OP_EX_13,
00161     OP_EX_14,
00162     OP_EX_15,
00163     OP_EX_16,
00164     OP_EX_17,
00165     OP_EX_18,
00166     OP_EX_19,
00167     OP_EX_1A,
00168     OP_EX_1B,
00169     OP_EX_1C,
00170     OP_EX_1D,
00171     OP_EX_1E,
00172     OP_EX_1F
00173 } DCPU_OpExtended;
00174
00175 //-----------------------------------------------------------------------------
00180 typedef enum
00181 {
00182     ARG_A = 0,
00183     ARG_B,
00184     ARG_C,
00185     ARG_X,
00186     ARG_Y,
00187     ARG_Z,
00188     ARG_I,
00189     ARG_J,
00190
00191     ARG_BRACKET_A,
00192     ARG_BRACKET_B,
00193     ARG_BRACKET_C,
00194     ARG_BRACKET_X,
00195     ARG_BRACKET_Y,
00196     ARG_BRACKET_Z,
00197     ARG_BRACKET_I,
00198     ARG_BRACKET_J,
00199
00200     ARG_WORD_A,
00201     ARG_WORD_B,
00202     ARG_WORD_C,
00203     ARG_WORD_X,
00204     ARG_WORD_Y,
00205     ARG_WORD_Z,
00206     ARG_WORD_I,
00207     ARG_WORD_J,
00208
00209     ARG_PUSH_POP_SP,
00210     ARG_PEEK_SP,
00211     ARG_WORD_SP,
00212     ARG_SP,
00213     ARG_PC,
00214     ARG_EX,
00215     ARG_NEXT_WORD,
00216     ARG_NEXT_LITERAL,
00217
00218     ARG_LITERAL_0,
00219     ARG_LITERAL_1,
```

```
00220     ARG_LITERAL_2,
00221     ARG_LITERAL_3,
00222     ARG_LITERAL_4,
00223     ARG_LITERAL_5,
00224     ARG_LITERAL_6,
00225     ARG_LITERAL_7,
00226     ARG_LITERAL_8,
00227     ARG_LITERAL_9,
00228     ARG_LITERAL_A,
00229     ARG_LITERAL_B,
00230     ARG_LITERAL_C,
00231     ARG_LITERAL_D,
00232     ARG_LITERAL_E,
00233     ARG_LITERAL_F,
00234     ARG_LITERAL_10,
00235     ARG_LITERAL_11,
00236     ARG_LITERAL_12,
00237     ARG_LITERAL_13,
00238     ARG_LITERAL_14,
00239     ARG_LITERAL_15,
00240     ARG_LITERAL_16,
00241     ARG_LITERAL_17,
00242     ARG_LITERAL_18,
00243     ARG_LITERAL_19,
00244     ARG_LITERAL_1A,
00245     ARG_LITERAL_1B,
00246     ARG_LITERAL_1C,
00247     ARG_LITERAL_1D,
00248     ARG_LITERAL_1E,
00249     ARG_LITERAL_1F
00250
00251 } DCPU_Argument;
00252
00253 //-----------------------------------------------------------------------------
00254 class DCPU; // Forward declaration - required by the plugin class
00255
00256 //-----------------------------------------------------------------------------
00260 typedef void (*DCPU_Callback)(DCPU *pclVM_);
00261
00262 //-----------------------------------------------------------------------------
00267 class DCPUPlugin : public LinkListNode
00268 {
00269 public:
00288     void Init(  K_USHORT usDeviceNumber_,
00289                 K_ULONG ulHWID_,
00290                 K_ULONG ulVID_,
00291                 K_USHORT usVersion_,
00292                 DCPU_Callback pfCallback_)
00293     {
00294         m_ulHWID = ulHWID_;
00295         m_ulVID = ulVID_;
00296         m_usDeviceNumber = usDeviceNumber_;
00297         m_usVersion = usVersion_;
00298         m_pfCallback = pfCallback_;
00299     }
00300
00311     void Enumerate( DCPU_Registers *pstRegisters_ )
00312     {
00313         pstRegisters_->A = (K_USHORT)(m_ulHWID & 0x0000FFFF);
00314         pstRegisters_->B = (K_USHORT)((m_ulHWID >> 16) & 0x0000FFFF);
00315         pstRegisters_->C = m_usVersion;
00316         pstRegisters_->X = (K_USHORT)(m_ulVID & 0x0000FFFF);
00317         pstRegisters_->Y = (K_USHORT)((m_ulVID >> 16) & 0x0000FFFF);
00318     }
00319
00327     void Interrupt( DCPU *pclCPU_ )
00328     {
00329         m_pfCallback(pclCPU_);
00330     }
00331
00339     K_USHORT GetDeviceNumber()
00340     {
00341         return m_usDeviceNumber;
00342     }
00343
00344     friend class DCPUPluginList;
00345 private:
00346     K_USHORT      m_usDeviceNumber;
00347     K_ULONG       m_ulHWID;
00348     K_ULONG       m_ulVID;
00349     K_USHORT      m_usVersion;
00350
00351     DCPU_Callback m_pfCallback;
00352 };
00353
00354 //-----------------------------------------------------------------------------
00359 class DCPU
```

```
00360 {
00361 public:
00375     void Init( K_USHORT *pusRAM_, K_USHORT usRAMSize_, const K_USHORT *pusROM_, K_USHORT usROMSize_ );
00376
00382     void RunOpcode();
00383
00391     DCPU_Registers *GetRegisters() { return &
      m_stRegisters; }
00392
00400     void SendInterrupt( K_USHORT usMessage_ );
00401
00409     void AddPlugin( DCPUPlugin *pclPlugin_ );
00410
00411 private:
00412
00413     // Basic opcodes
00414     void SET();
00415     void ADD();
00416     void SUB();
00417     void MUL();
00418     void MLI();
00419     void DIV();
00420     void DVI();
00421     void MOD();
00422     void MDI();
00423     void AND();
00424     void BOR();
00425     void XOR();
00426     void SHR();
00427     void ASR();
00428     void SHL();
00429     bool IFB();
00430     bool IFC();
00431     bool IFE();
00432     bool IFN();
00433     bool IFG();
00434     bool IFA();
00435     bool IFL();
00436     bool IFU();
00437     void ADX();
00438     void SBX();
00439     void STI();
00440     void STD();
00441
00442     // Extended opcodes
00443     void JSR();
00444     void INT();
00445     void IAG();
00446     void IAS();
00447     void RFI();
00448     void IAQ();
00449     void HWN();
00450     void HWQ();
00451     void HWI();
00452
00460     K_UCHAR GetOperand( K_UCHAR ucOpType_, K_USHORT **pusResult_ );
00461
00462
00468     void ProcessInterruptQueue();
00469
00470     DCPU_Registers m_stRegisters;
00471
00472     K_USHORT *a;
00473     K_USHORT *b;
00474
00475     K_USHORT m_usTempA;
00476
00477     K_USHORT *m_pusRAM;
00478     K_USHORT m_usRAMSize;
00479
00480     K_USHORT *m_pusROM;
00481     K_USHORT m_usROMSize;
00482
00483     K_ULONG  m_ulCycleCount;
00484
00485     K_BOOL   m_bInterruptQueueing;
00486     K_UCHAR  m_ucQueueLevel;
00487     K_USHORT m_ausInterruptQueue[ 8 ];
00488
00489     DoubleLinkList m_clPluginList;
00490 };
00491
00492 #endif
```

14.45 /home/moslevin2/mark3/embedded/stage/src/debug_tokens.h File Reference

Hex codes/translation tables used for efficient string tokenization.

Macros

- #define BLOCKING_CPP 0x0001 /* SUBSTITUTE="blocking.cpp" */

  Source file names start at 0x0000.
- #define **DRIVER_CPP** 0x0002 /* SUBSTITUTE="driver.cpp" */
- #define **KERNEL_CPP** 0x0003 /* SUBSTITUTE="kernel.cpp" */
- #define **LL_CPP** 0x0004 /* SUBSTITUTE="ll.cpp" */
- #define **MESSAGE_CPP** 0x0005 /* SUBSTITUTE="message.cpp" */
- #define **MUTEX_CPP** 0x0006 /* SUBSTITUTE="mutex.cpp" */
- #define **PROFILE_CPP** 0x0007 /* SUBSTITUTE="profile.cpp" */
- #define **QUANTUM_CPP** 0x0008 /* SUBSTITUTE="quantum.cpp" */
- #define **SCHEDULER_CPP** 0x0009 /* SUBSTITUTE="scheduler.cpp" */
- #define **SEMAPHORE_CPP** 0x000A /* SUBSTITUTE="semaphore.cpp" */
- #define **THREAD_CPP** 0x000B /* SUBSTITUTE="thread.cpp" */
- #define **THREADLIST_CPP** 0x000C /* SUBSTITUTE="threadlist.cpp" */
- #define **TIMERLIST_CPP** 0x000D /* SUBSTITUTE="timerlist.cpp" */
- #define **KERNELSWI_CPP** 0x000E /* SUBSTITUTE="kernelswi.cpp" */
- #define **KERNELTIMER_CPP** 0x000F /* SUBSTITUTE="kerneltimer.cpp" */
- #define **KPROFILE_CPP** 0x0010 /* SUBSTITUTE="kprofile.cpp" */
- #define **THREADPORT_CPP** 0x0011 /* SUBSTITUTE="threadport.cpp" */
- #define BLOCKING_H 0x1000 /* SUBSTITUTE="blocking.h" */

  Header file names start at 0x1000.
- #define **DRIVER_H** 0x1001 /* SUBSTITUTE="driver.h" */
- #define **KERNEL_H** 0x1002 /* SUBSTITUTE="kernel.h" */
- #define **KERNELTYPES_H** 0x1003 /* SUBSTITUTE="kerneltypes.h" */
- #define **LL_H** 0x1004 /* SUBSTITUTE="ll.h" */
- #define **MANUAL_H** 0x1005 /* SUBSTITUTE="manual.h" */
- #define **MARK3CFG_H** 0x1006 /* SUBSTITUTE="mark3cfg.h" */
- #define **MESSAGE_H** 0x1007 /* SUBSTITUTE="message.h" */
- #define **MUTEX_H** 0x1008 /* SUBSTITUTE="mutex.h" */
- #define **PROFILE_H** 0x1009 /* SUBSTITUTE="profile.h" */
- #define **PROFILING_RESULTS_H** 0x100A /* SUBSTITUTE="profiling_results.h" */
- #define **QUANTUM_H** 0x100B /* SUBSTITUTE="quantum.h" */
- #define **SCHEDULER_H** 0x100C /* SUBSTITUTE="scheduler.h" */
- #define **SEMAPHORE_H** 0x100D /* SUBSTITUTE="ksemaphore.h" */
- #define **THREAD_H** 0x100E /* SUBSTITUTE="thread.h" */
- #define **THREADLIST_H** 0x100F /* SUBSTITUTE="threadlist.h" */
- #define **TIMERLIST_H** 0x1010 /* SUBSTITUTE="timerlist.h" */
- #define **KERNELSWI_H** 0x1011 /* SUBSTITUTE="kernelswi.h */
- #define **KERNELTIMER_H** 0x1012 /* SUBSTITUTE="kerneltimer.h */
- #define **KPROFILE_H** 0x1013 /* SUBSTITUTE="kprofile.h" */
- #define **THREADPORT_H** 0x1014 /* SUBSTITUTE="threadport.h" */
- #define STR_PANIC 0x2000 /* SUBSTITUTE="!Panic!" */

  Indexed strings start at 0x2000.
- #define **STR_MARK3_INIT** 0x2001 /* SUBSTITUTE="Initializing Kernel Objects" */
- #define **STR_KERNEL_ENTER** 0x2002 /* SUBSTITUTE="Starting Kernel" */
- #define **STR_THREAD_START** 0x2003 /* SUBSTITUTE="Switching to First Thread" */
- #define **STR_START_ERROR** 0x2004 /* SUBSTITUTE="Error starting kernel - function should never return" */

- #define **STR_THREAD_CREATE** 0x2005 /∗ SUBSTITUTE="Creating Thread" ∗/
- #define **STR_STACK_SIZE_1** 0x2006 /∗ SUBSTITUTE=" Stack Size: %1" ∗/
- #define **STR_PRIORITY_1** 0x2007 /∗ SUBSTITUTE=" Priority: %1" ∗/
- #define **STR_THREAD_ID_1** 0x2008 /∗ SUBSTITUTE=" Thread ID: %1" ∗/
- #define **STR_ENTRYPOINT_1** 0x2009 /∗ SUBSTITUTE=" EntryPoint: %1" ∗/
- #define **STR_CONTEXT_SWITCH_1** 0x200A /∗ SUBSTITUTE="Context Switch To Thread: %1" ∗/
- #define **STR_IDLING** 0x200B /∗ SUBSTITUTE="Idling CPU" ∗/
- #define **STR_WAKEUP** 0x200C /∗ SUBSTITUTE="Waking up" ∗/
- #define **STR_SEMAPHORE_PEND_1** 0x200D /∗ SUBSTITUTE="Semaphore Pend: %1" ∗/
- #define **STR_SEMAPHORE_POST_1** 0x200E /∗ SUBSTITUTE="Semaphore Post: %1" ∗/
- #define **STR_MUTEX_CLAIM_1** 0x200F /∗ SUBSTITUTE="Mutex Claim: %1" ∗/
- #define **STR_MUTEX_RELEASE_1** 0x2010 /∗ SUBSTITUTE="Mutex Release: %1" ∗/
- #define **STR_THREAD_BLOCK_1** 0x2011 /∗ SUBSTITUTE="Thread %1 Blocked" ∗/
- #define **STR_THREAD_UNBLOCK_1** 0x2012 /∗ SUBSTITUTE="Thread %1 Unblocked" ∗/
- #define **STR_ASSERT_FAILED** 0x2013 /∗ SUBSTITUTE="Assertion Failed" ∗/
- #define **STR_SCHEDULE_1** 0x2014 /∗ SUBSTITUTE="Scheduler chose %1" ∗/
- #define **STR_THREAD_START_1** 0x2015 /∗ SUBSTITUTE="Thread Start: %1" ∗/
- #define **STR_THREAD_EXIT_1** 0x2016 /∗ SUBSTITUTE="Thread Exit: %1" ∗/
- #define **STR_UNDEFINED** 0xFFFF /∗ SUBSTITUTE="UNDEFINED" ∗/

14.45.1 Detailed Description

Hex codes/translation tables used for efficient string tokenization. We use this for efficiently encoding strings used for kernel traces, debug prints, etc. The upside - this is really fast and efficient for encoding strings and data. Downside? The tools need to parse this header file in order to convert the enumerated data into actual strings, decoding them.

Definition in file debug_tokens.h.

14.46 debug_tokens.h

```
/*===========================================================================
     _____     _____     _____     _____
 ___|    _|__ __|_    |__ __|__   |__ __| __  |__ _____
|    \  /  | ||    \    ||     |     ||  |/ /    ||___   |
|     \/   | ||     \   ||     \     ||     \    ||___   |
|__/\__/|__|_||__|\__\ __||__|\__\ __||__|\__\ __||_____|
    |_____|      |_____|      |_____|      |_____|

--[Mark3 Realtime Platform]--------------------------------------------------

Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
See license.txt for more information
===========================================================================*/
#ifndef __DEBUG_TOKENS_H__
#define __DEBUG_TOKENS_H__
//---------------------------------------------------------------------------
#define BLOCKING_CPP        0x0001      /* SUBSTITUTE="blocking.cpp" */
#define DRIVER_CPP          0x0002      /* SUBSTITUTE="driver.cpp" */
#define KERNEL_CPP          0x0003      /* SUBSTITUTE="kernel.cpp" */
#define LL_CPP              0x0004      /* SUBSTITUTE="ll.cpp" */
#define MESSAGE_CPP         0x0005      /* SUBSTITUTE="message.cpp" */
#define MUTEX_CPP           0x0006      /* SUBSTITUTE="mutex.cpp" */
#define PROFILE_CPP         0x0007      /* SUBSTITUTE="profile.cpp" */
#define QUANTUM_CPP         0x0008      /* SUBSTITUTE="quantum.cpp" */
#define SCHEDULER_CPP       0x0009      /* SUBSTITUTE="scheduler.cpp" */
#define SEMAPHORE_CPP       0x000A      /* SUBSTITUTE="semaphore.cpp" */
#define THREAD_CPP          0x000B      /* SUBSTITUTE="thread.cpp" */
#define THREADLIST_CPP      0x000C      /* SUBSTITUTE="threadlist.cpp" */
#define TIMERLIST_CPP       0x000D      /* SUBSTITUTE="timerlist.cpp" */
#define KERNELSWI_CPP       0x000E      /* SUBSTITUTE="kernelswi.cpp" */
#define KERNELTIMER_CPP     0x000F      /* SUBSTITUTE="kerneltimer.cpp" */
#define KPROFILE_CPP        0x0010      /* SUBSTITUTE="kprofile.cpp" */
#define THREADPORT_CPP      0x0011      /* SUBSTITUTE="threadport.cpp" */

//---------------------------------------------------------------------------
#define BLOCKING_H          0x1000      /* SUBSTITUTE="blocking.h" */
```

```
00050 #define DRIVER_H            0x1001      /* SUBSTITUTE="driver.h" */
00051 #define KERNEL_H            0x1002      /* SUBSTITUTE="kernel.h" */
00052 #define KERNELTYPES_H       0x1003      /* SUBSTITUTE="kerneltypes.h" */
00053 #define LL_H                0x1004      /* SUBSTITUTE="ll.h" */
00054 #define MANUAL_H            0x1005      /* SUBSTITUTE="manual.h" */
00055 #define MARK3CFG_H          0x1006      /* SUBSTITUTE="mark3cfg.h" */
00056 #define MESSAGE_H           0x1007      /* SUBSTITUTE="message.h" */
00057 #define MUTEX_H             0x1008      /* SUBSTITUTE="mutex.h" */
00058 #define PROFILE_H           0x1009      /* SUBSTITUTE="profile.h" */
00059 #define PROFILING_RESULTS_H 0x100A      /* SUBSTITUTE="profiling_results.h" */
00060 #define QUANTUM_H           0x100B      /* SUBSTITUTE="quantum.h" */
00061 #define SCHEDULER_H         0x100C      /* SUBSTITUTE="scheduler.h" */
00062 #define SEMAPHORE_H         0x100D      /* SUBSTITUTE="ksemaphore.h" */
00063 #define THREAD_H            0x100E      /* SUBSTITUTE="thread.h" */
00064 #define THREADLIST_H        0x100F      /* SUBSTITUTE="threadlist.h" */
00065 #define TIMERLIST_H         0x1010      /* SUBSTITUTE="timerlist.h" */
00066 #define KERNELSWI_H         0x1011      /* SUBSTITUTE="kernelswi.h */
00067 #define KERNELTIMER_H       0x1012      /* SUBSTITUTE="kerneltimer.h */
00068 #define KPROFILE_H          0x1013      /* SUBSTITUTE="kprofile.h" */
00069 #define THREADPORT_H        0x1014      /* SUBSTITUTE="threadport.h" */
00070
00071 //---------------------------------------------------------------------------
00073 #define STR_PANIC               0x2000      /* SUBSTITUTE="!Panic!" */
00074 #define STR_MARK3_INIT          0x2001      /* SUBSTITUTE="Initializing Kernel Objects" */
00075 #define STR_KERNEL_ENTER        0x2002      /* SUBSTITUTE="Starting Kernel" */
00076 #define STR_THREAD_START        0x2003      /* SUBSTITUTE="Switching to First Thread" */
00077 #define STR_START_ERROR         0x2004      /* SUBSTITUTE="Error starting kernel - function should never
      return" */
00078 #define STR_THREAD_CREATE       0x2005      /* SUBSTITUTE="Creating Thread" */
00079 #define STR_STACK_SIZE_1        0x2006      /* SUBSTITUTE="  Stack Size: %1" */
00080 #define STR_PRIORITY_1          0x2007      /* SUBSTITUTE="  Priority: %1" */
00081 #define STR_THREAD_ID_1         0x2008      /* SUBSTITUTE="  Thread ID: %1" */
00082 #define STR_ENTRYPOINT_1        0x2009      /* SUBSTITUTE="  EntryPoint: %1" */
00083 #define STR_CONTEXT_SWITCH_1    0x200A      /* SUBSTITUTE="Context Switch To Thread: %1" */
00084 #define STR_IDLING              0x200B      /* SUBSTITUTE="Idling CPU" */
00085 #define STR_WAKEUP              0x200C      /* SUBSTITUTE="Waking up" */
00086 #define STR_SEMAPHORE_PEND_1    0x200D      /* SUBSTITUTE="Semaphore Pend: %1" */
00087 #define STR_SEMAPHORE_POST_1    0x200E      /* SUBSTITUTE="Semaphore Post: %1" */
00088 #define STR_MUTEX_CLAIM_1       0x200F      /* SUBSTITUTE="Mutex Claim: %1" */
00089 #define STR_MUTEX_RELEASE_1     0x2010      /* SUBSTITUTE="Mutex Release: %1" */
00090 #define STR_THREAD_BLOCK_1      0x2011      /* SUBSTITUTE="Thread %1 Blocked" */
00091 #define STR_THREAD_UNBLOCK_1    0x2012      /* SUBSTITUTE="Thread %1 Unblocked" */
00092 #define STR_ASSERT_FAILED       0x2013      /* SUBSTITUTE="Assertion Failed" */
00093 #define STR_SCHEDULE_1          0x2014      /* SUBSTITUTE="Scheduler chose %1" */
00094 #define STR_THREAD_START_1      0x2015      /* SUBSTITUTE="Thread Start: %1" */
00095 #define STR_THREAD_EXIT_1       0x2016      /* SUBSTITUTE="Thread Exit: %1" */
00096
00097 //---------------------------------------------------------------------------
00098 #define STR_UNDEFINED           0xFFFF      /* SUBSTITUTE="UNDEFINED" */
00099 #endif
```

14.47 /home/moslevin2/mark3/embedded/stage/src/draw.h File Reference

Raster graphics APIs Description: Implements basic drawing functionality.

```
#include "kerneltypes.h"
#include "font.h"
#include "colorspace.h"
```

Classes

- struct DrawPoint_t

  Defines a pixel.
- struct DrawLine_t

  Defines a simple line.
- struct DrawRectangle_t

  Defines a rectangle.
- struct DrawCircle_t

  Defines a circle.
- struct DrawEllipse_t

Defines a ellipse.

- struct DrawBitmap_t

  Defines a bitmap.

- struct DrawStamp_t

  Defines a 1-bit 2D bitmap of arbitrary resolution.

- struct DrawText_t

  Defines a bitmap-rendered string.

- struct DrawWindow_t

  Defines the active window - establishes boundaries for drawing on the current display.

- struct DrawMove_t

  Simple 2D copy/paste.

- struct DrawVector_t

  Specifies a single 2D point.

- struct DrawPoly_t

  Defines the structure of an arbitrary polygon.

Enumerations

- enum **DisplayEvent_t** {
  DISPLAY_EVENT_SET_PIXEL = 0x00, **DISPLAY_EVENT_GET_PIXEL**, **DISPLAY_EVENT_CLEAR**, **DISPLAY_EVENT_LINE**,
  DISPLAY_EVENT_RECTANGLE, **DISPLAY_EVENT_CIRCLE**, **DISPLAY_EVENT_ELLIPSE**, **DISPLAY_EVENT_BITMAP**,
  DISPLAY_EVENT_STAMP, **DISPLAY_EVENT_TEXT**, **DISPLAY_EVENT_MOVE**, **DISPLAY_EVENT_POLY** }

14.47.1 Detailed Description

Raster graphics APIs Description: Implements basic drawing functionality. This forms a hardware abstraction layer which requires a backend for rendering.

Definition in file draw.h.

14.48 draw.h

```
00001 /*=========================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__   ___|_    |__   ___|__   |__   ___| __   |__   ______
00004 |     \  /   | ||     \       ||      |      ||   |/ /      ||___    |
00005 |      \/    | ||      \      ||      \      ||      \      ||___    |
00006 |__/\__/|__|_||__|\__\   __||__|\__\   __||__|\__\   __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00021 //---------------------------------------------------------------------------
00022
00023 #ifndef __DRAW_H_
00024 #define __DRAW_H_
00025
00026 #include "kerneltypes.h"
00027 #include "font.h"
00028 #include "colorspace.h"
00029
00030 //---------------------------------------------------------------------------
00031 // Event definitions for 2D hardware accelerated graphics functions
00032 typedef enum
00033 {
00034     //--[Mandatory for a display driver]-----------------------------------
```

```
00035     DISPLAY_EVENT_SET_PIXEL = 0x00,
00036     DISPLAY_EVENT_GET_PIXEL,
00037
00038     //--[Optional if supported in hardware]---------------------------------
00039     DISPLAY_EVENT_CLEAR,
00040     DISPLAY_EVENT_LINE,
00041     DISPLAY_EVENT_RECTANGLE,
00042     DISPLAY_EVENT_CIRCLE,
00043     DISPLAY_EVENT_ELLIPSE,
00044     DISPLAY_EVENT_BITMAP,
00045     DISPLAY_EVENT_STAMP,
00046     DISPLAY_EVENT_TEXT,
00047     DISPLAY_EVENT_MOVE,
00048     DISPLAY_EVENT_POLY
00049 } DisplayEvent_t;
00050
00051 //-----------------------------------------------------------------------------
00055 typedef struct
00056 {
00057     K_USHORT usX;
00058     K_USHORT usY;
00059     COLOR uColor;
00060 } DrawPoint_t;
00061
00062 //-----------------------------------------------------------------------------
00066 typedef struct
00067 {
00068     K_USHORT usX1;
00069     K_USHORT usX2;
00070     K_USHORT usY1;
00071     K_USHORT usY2;
00072     COLOR uColor;
00073 } DrawLine_t;
00074 //-----------------------------------------------------------------------------
00078 typedef struct
00079 {
00080     K_USHORT usLeft;
00081     K_USHORT usTop;
00082     K_USHORT usRight;
00083     K_USHORT usBottom;
00084     COLOR uLineColor;
00085     K_BOOL bFill;
00086     COLOR uFillColor;
00087 } DrawRectangle_t;
00088 //-----------------------------------------------------------------------------
00092 typedef struct
00093 {
00094     K_USHORT usX;
00095     K_USHORT usY;
00096     K_USHORT usRadius;
00097     COLOR uLineColor;
00098     K_BOOL bFill;
00099     COLOR uFillColor;
00100 } DrawCircle_t;
00101 //-----------------------------------------------------------------------------
00105 typedef struct
00106 {
00107     K_USHORT usX;
00108     K_USHORT usY;
00109     K_USHORT usHeight;
00110     K_USHORT usWidth;
00111     COLOR uColor;
00112 } DrawEllipse_t;
00113 //-----------------------------------------------------------------------------
00117 typedef struct
00118 {
00119     K_USHORT usX;
00120     K_USHORT usY;
00121     K_USHORT usWidth;
00122     K_USHORT usHeight;
00123     K_UCHAR ucBPP;
00124     K_UCHAR *pucData;
00125 } DrawBitmap_t;
00126 //-----------------------------------------------------------------------------
00130 typedef struct
00131 {
00132     K_USHORT usX;
00133     K_USHORT usY;
00134     K_USHORT usWidth;
00135     K_USHORT usHeight;
00136     COLOR uColor;
00137     K_UCHAR *pucData;
00138 } DrawStamp_t;    // monochrome stamp, bitpacked 8bpp
00139
00140 //-----------------------------------------------------------------------------
00144 typedef struct
00145 {
```

```
00146     K_USHORT usLeft;
00147     K_USHORT usTop;
00148     COLOR uColor;
00149     Font_t *pstFont;
00150     const K_CHAR *pcString;
00151 } DrawText_t;
00152
00153 //---------------------------------------------------------------------------
00159 typedef struct
00160 {
00161     K_USHORT usLeft;
00162     K_USHORT usRight;
00163     K_USHORT usTop;
00164     K_USHORT usBottom;
00165 } DrawWindow_t;
00166
00167 //---------------------------------------------------------------------------
00172 typedef struct
00173 {
00174     K_USHORT usSrcX;
00175     K_USHORT usSrcY;
00176     K_USHORT usDstX;
00177     K_USHORT usDstY;
00178     K_USHORT usCopyHeight;
00179     K_USHORT usCopyWidth;
00180 } DrawMove_t;
00181
00182 //---------------------------------------------------------------------------
00188 typedef struct
00189 {
00190     K_USHORT usX;
00191     K_USHORT usY;
00192 } DrawVector_t;
00193
00194 //---------------------------------------------------------------------------
00199 typedef struct
00200 {
00201     K_USHORT     usNumPoints;
00202     COLOR        uColor;
00203     K_BOOL       bFill;
00204     DrawVector_t *pstVector;
00205 } DrawPoly_t;
00206
00207 #endif //__DRAW_H_
```

14.49 /home/moslevin2/mark3/embedded/stage/src/driver.cpp File Reference

Device driver/hardware abstraction layer.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "kernel_debug.h"
#include "driver.h"
```

Classes

- class DevNull

  This class implements the "default" driver (/dev/null)

Macros

- #define **__FILE_ID__** DRIVER_CPP

Functions

- static K_UCHAR **DrvCmp** (const K_CHAR *szStr1_, const K_CHAR *szStr2_)

Variables

- static DevNull **clDevNull**

14.49.1 Detailed Description

Device driver/hardware abstraction layer.

Definition in file driver.cpp.

14.50 driver.cpp

```
00001 /*=============================================================================
00002     ______     ______     ______     ______
00003  ___|    _|__  __|_    |__  __|__   |__  __| __  |__  _______
00004 |    \  /  | ||    \       ||      |      ||  |/ /      ||___    |
00005 |     \/   | ||     \      ||      \      ||     \      ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||_______|
00007     |______|      |______|      |______|      |______|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00021 #include "kerneltypes.h"
00022 #include "mark3cfg.h"
00023 #include "kernel_debug.h"
00024 #include "driver.h"
00025
00026 //---------------------------------------------------------------------------
00027 #if defined __FILE_ID__
00028     #undef __FILE_ID__
00029 #endif
00030 #define __FILE_ID__     DRIVER_CPP
00031
00032 //---------------------------------------------------------------------------
00033 #if KERNEL_USE_DRIVER
00034
00035 DoubleLinkList DriverList::m_clDriverList;
00036
00040 class DevNull : public Driver
00041 {
00042 public:
00043     virtual void Init() { SetName("/dev/null"); };
00044     virtual K_UCHAR Open() { return 0; }
00045     virtual K_UCHAR Close() { return 0; }
00046
00047     virtual K_USHORT Read( K_USHORT usBytes_,
00048     K_UCHAR *pucData_){ return 0; }
00049
00050     virtual K_USHORT Write( K_USHORT usBytes_,
00051     K_UCHAR *pucData_) { return 0; }
00052
00053     virtual K_USHORT Control( K_USHORT usEvent_,
00054         void *pvDataIn_,
00055         K_USHORT usSizeIn_,
00056         void *pvDataOut_,
00057         K_USHORT usSizeOut_ ) { return 0; }
00058
00059 };
00060
00061 //---------------------------------------------------------------------------
00062 static DevNull clDevNull;
00063
00064 //---------------------------------------------------------------------------
00065 static K_UCHAR DrvCmp( const K_CHAR *szStr1_, const K_CHAR *szStr2_ )
00066 {
00067     K_CHAR *szTmp1 = (K_CHAR*) szStr1_;
00068     K_CHAR *szTmp2 = (K_CHAR*) szStr2_;
00069
00070     while (*szTmp1 && *szTmp2)
00071     {
00072         if (*szTmp1++ != *szTmp2++)
00073         {
00074             return 0;
00075         }
00076     }
00077
```

```
00078     // Both terminate at the same length
00079     if (!(*szTmp1) && !(*szTmp2))
00080     {
00081         return 1;
00082     }
00083 
00084     return 0;
00085 }
00086 
00087 //---------------------------------------------------------------------------
00088 void DriverList::Init()
00089 {
00090     // Ensure we always have at least one entry - a default in case no match
00091     // is found (/dev/null)
00092     clDevNull.Init();
00093     Add(&clDevNull);
00094 }
00095 
00096 //---------------------------------------------------------------------------
00097 Driver *DriverList::FindByPath( const K_CHAR *m_pcPath )
00098 {
00099     KERNEL_ASSERT( m_pcPath );
00100     Driver *pclTemp = static_cast<Driver*>(m_clDriverList.
    GetHead());
00101 
00102     while (pclTemp)
00103     {
00104         if(DrvCmp(m_pcPath, pclTemp->GetPath()))
00105         {
00106             return pclTemp;
00107         }
00108         pclTemp = static_cast<Driver*>(pclTemp->GetNext());
00109     }
00110     return &clDevNull;
00111 }
00112 
00113 #endif
```

14.51 /home/moslevin2/mark3/embedded/stage/src/driver.h File Reference

Driver abstraction framework.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "ll.h"
```

Classes

- class Driver

  Base device-driver class used in hardware abstraction.
- class DriverList

  List of Driver objects used to keep track of all device drivers in the system.

14.51.1 Detailed Description

Driver abstraction framework.

14.51.2 Intro

This is the basis of the driver framework. In the context of Mark3, drivers don't necessarily have to be based on physical hardware peripherals. They can be used to represent algorithms (such as random number generators), files, or protocol stacks. Unlike FunkOS, where driver IO is protected automatically by a mutex, we do not use this kind of protection - we leave it up to the driver implementor to do what's right in its own context. This also frees up the driver to implement all sorts of other neat stuff, like sending messages to threads associated with the driver.

Drivers are implemented as character devices, with the standard array of posix-style accessor methods for reading, writing, and general driver control.

A global driver list is provided as a convenient and minimal "filesystem" structure, in which devices can be accessed by name.

14.51.3 Driver Design

A device driver needs to be able to perform the following operations: -Initialize a peripheral -Start/stop a peripheral -Handle I/O control operations -Perform various read/write operations

At the end of the day, that's pretty much all a device driver has to do, and all of the functionality that needs to be presented to the developer.

We abstract all device drivers using a base-class which implements the following methods: -Start/Open -Stop/Close -Control -Read -Write

A basic driver framework and API can thus be implemented in five function calls - that's it! You could even reduce that further by handling the initialize, start, and stop operations inside the "control" operation.

14.51.4 Driver API

In C++, we can implement this as a class to abstract these event handlers, with virtual void functions in the base class overridden by the inherited objects.

To add and remove device drivers from the global table, we use the following methods:

```
void DriverList::Add( Driver *pclDriver_ );
void DriverList::Remove( Driver *pclDriver_ );
```

DriverList::Add()/Remove() takes a single arguments the pointer to he object to operate on.

Once a driver has been added to the table, drivers are opened by NAME using DriverList::FindByName("/dev/name"). This function returns a pointer to the specified driver if successful, or to a built in /dev/null device if the path name is invalid. After a driver is open, that pointer is used for all other driver access functions.

This abstraction is incredibly useful any peripheral or service can be accessed through a consistent set of APIs, that make it easy to substitute implementations from one platform to another. Portability is ensured, the overhead is negligible, and it emphasizes the reuse of both driver and application code as separate entities.

Consider a system with drivers for I2C, SPI, and UART peripherals - under our driver framework, an application can initialize these peripherals and write a greeting to each using the same simple API functions for all drivers:

```
pclI2C  = DriverList::FindByName("/dev/i2c");
pclUART = DriverList::FindByName("/dev/tty0");
pclSPI  = DriverList::FindByName("/dev/spi");

pclI2C->Write(12,"Hello World!");
pclUART->Write(12, "Hello World!");
pclSPI->Write(12, "Hello World!");
```

Definition in file driver.h.

14.52 driver.h

```
00001 /*=============================================================================
00002      _____       _____       _____       _____
00003  ___|    _|__  __|_    |__  __|__   |__  __| __  |__  _______
00004 |    \  /  | ||    \       ||     |     ||  |/ /     ||___   |
00005 |     \/   | ||     \      ||     \     ||     \     ||___   |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||_______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]-----------------------------------------------
```

```
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00105 #include "kerneltypes.h"
00106 #include "mark3cfg.h"
00107
00108 #include "ll.h"
00109
00110 #ifndef __DRIVER_H__
00111 #define __DRIVER_H__
00112
00113 #if KERNEL_USE_DRIVER
00114
00115 class DriverList;
00116 //---------------------------------------------------------------------------
00121 class Driver : public LinkListNode
00122 {
00123 public:
00129     virtual void Init() = 0;
00130
00138     virtual K_UCHAR Open() = 0;
00139
00147     virtual K_UCHAR Close() = 0;
00148
00164     virtual K_USHORT Read( K_USHORT usBytes_,
00165                                 K_UCHAR *pucData_) = 0;
00166
00183     virtual K_USHORT Write( K_USHORT usBytes_,
00184                                  K_UCHAR *pucData_) = 0;
00185
00208     virtual K_USHORT Control( K_USHORT usEvent_,
00209                                   void *pvDataIn_,
00210                                   K_USHORT usSizeIn_,
00211                                   void *pvDataOut_,
00212                                   K_USHORT usSizeOut_ ) = 0;
00213
00222     void SetName( const K_CHAR *pcName_ ) { m_pcPath = pcName_; }
00223
00231     const K_CHAR *GetPath() { return m_pcPath; }
00232
00233 private:
00234
00236     const K_CHAR *m_pcPath;
00237 };
00238
00239 //---------------------------------------------------------------------------
00244 class DriverList
00245 {
00246 public:
00254     static void Init();
00255
00264     static void Add( Driver *pclDriver_ ) { m_clDriverList.
      Add(pclDriver_); }
00265
00274     static void Remove( Driver *pclDriver_ ) { m_clDriverList.
      Remove(pclDriver_); }
00275
00282     static Driver *FindByPath( const K_CHAR *m_pcPath );
00283
00284 private:
00285
00287     static DoubleLinkList m_clDriverList;
00288 };
00289
00290 #endif //KERNEL_USE_DRIVER
00291
00292 #endif
```

14.53 /home/moslevin2/mark3/embedded/stage/src/fixed_heap.cpp File Reference

Fixed-block-size memory management.

```
#include "kerneltypes.h"
#include "fixed_heap.h"
#include "threadport.h"
```

14.53.1 Detailed Description

Fixed-block-size memory management. This allows a user to create heaps containing multiple lists, each list containing a linked-list of blocks that are each the same size. As a result of the linked-list format, these heaps are very fast - requiring only a linked list pop/push to allocated/free memory. Array traversal is required to allow for the optimal heap to be used. Blocks are chosen from the first heap with free blocks large enough to fulfill the request.

Only simple malloc/free functionlality is supported in this implementation, no complex vector-allocate or reallocation functions are supported.

Heaps are protected by critical section, and are thus thread-safe.

When creating a heap, a user supplies an array of heap configuration objects, which determines how many objects of what size are available.

The configuration objects are defined from smallest list to largest, the memory to back the heap is supplied as a pointer to a "blob" of memory which will be used to create the underlying heap objects that make up the heap internal data structures. This blob must be large enough to contain all of the requested heap objects, with all of the additional metadata required to manage the objects.

Multiple heaps can be created using this library (heaps are not singleton).

Definition in file fixed_heap.cpp.

14.54 fixed_heap.cpp

```
00001 /*=====================================================================================
00002      _____          _____          _____          _____
00003  ___|    _|__   ___|_    |__   ___|__   |__   ___| __  |__   ______
00004 |    \  /   | ||     \       ||      |      ||   |/ /      ||___    |
00005 |     \/    | ||      \      ||      \      ||      \      ||___    |
00006 |__/\__/|__|_||__|\__\  ___||__|\__\  ___||__|\__\  ___||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 =====================================================================================*/
00043 #include "kerneltypes.h"
00044 #include "fixed_heap.h"
00045 #include "threadport.h"
00046
00047 //---------------------------------------------------------------------------
00048 void *BlockHeap::Create( void *pvHeap_, K_USHORT usSize_, K_USHORT usBlockSize_ )
00049 {
00050     K_USHORT usNodeCount = usSize_ /
00051                                 (usBlockSize_ + sizeof(LinkListNode) + sizeof(void*));
00052     K_ADDR adNode = (K_ADDR)pvHeap_;
00053     K_ADDR adMaxNode = (K_ADDR)((K_ADDR)pvHeap_ + (K_ADDR)usSize_);
00054     m_clList.Init();
00055
00056     // Create a heap (linked-list nodes + byte pool) in the middle of
00057     // the data blob
00058     for (K_USHORT i = 0; i < usNodeCount; i++ )
00059     {
00060         // Create a pointer back to the source list.
00061         BlockHeap **pclTemp = (BlockHeap**)(adNode + sizeof(
      LinkListNode));
00062         *pclTemp = (BlockHeap*)(this);
00063
00064         // Add the node to the block list
00065         m_clList.Add( (LinkListNode*)adNode );
00066
00067         // Move the pointer in the pool to point to the next block to allocate
00068         adNode += (usBlockSize_ + sizeof(LinkListNode) + sizeof(
      BlockHeap*));
00069
00070         // Bail if we would be going past the end of the allocated space...
00071         if ((K_ULONG)adNode >= (K_ULONG)adMaxNode)
00072         {
00073             break;
00074         }
00075     }
00076     m_usBlocksFree = usNodeCount;
00077
00078     // Return pointer to end of heap (used for heap-chaining)
```

```
00079     return (void*)adNode;
00080 }
00081
00082 //---------------------------------------------------------------------------
00083 void *BlockHeap::Alloc()
00084 {
00085     LinkListNode *pclNode = m_clList.GetHead();
00086
00087     // Return the first node from the head of the list
00088     if (pclNode)
00089     {
00090         m_clList.Remove( pclNode );
00091         m_usBlocksFree--;
00092
00093         // Account for block-management metadata
00094         return (void*)((K_ADDR)pclNode + sizeof(LinkListNode) + sizeof(void*));
00095     }
00096
00097     // Or null, if the heap is empty.
00098     return 0;
00099 }
00100
00101 //---------------------------------------------------------------------------
00102 void BlockHeap::Free( void* pvData_ )
00103 {
00104     // Compute the address of the original object (class metadata included)
00105     LinkListNode *pclNode = (LinkListNode*)((K_ADDR)pvData_ - sizeof(
      LinkListNode) - sizeof(void*));
00106
00107     // Add the object back to the block data pool
00108     m_clList.Add(pclNode);
00109     m_usBlocksFree++;
00110 }
00111
00112 //---------------------------------------------------------------------------
00113 void FixedHeap::Create( void *pvHeap_, HeapConfig *pclHeapConfig_ )
00114 {
00115     K_USHORT i = 0;
00116     void *pvTemp = pvHeap_;
00117     while( pclHeapConfig_[i].m_usBlockSize != 0)
00118     {
00119         pvTemp = pclHeapConfig_[i].m_clHeap.Create
00120                     (pvTemp,
00121                      (pclHeapConfig_[i].m_usBlockSize +sizeof(LinkListNode) + sizeof(void*)) *
00122                      pclHeapConfig_[i].m_usBlockCount,
00123                      pclHeapConfig_[i].m_usBlockSize );
00124         i++;
00125     }
00126     m_paclHeaps = pclHeapConfig_;
00127 }
00128
00129 //---------------------------------------------------------------------------
00130 void *FixedHeap::Alloc( K_USHORT usSize_ )
00131 {
00132     void *pvRet = 0;
00133     K_USHORT i = 0;
00134
00135     // Go through all heaps, trying to find the smallest one that
00136     // has a free item to satisfy the allocation
00137     while (m_paclHeaps[i].m_usBlockSize != 0)
00138     {
00139         CS_ENTER();
00140         if ((m_paclHeaps[i].m_usBlockSize >= usSize_) && m_paclHeaps[i].m_clHeap.
      IsFree() )
00141         {
00142             // Found a match
00143             pvRet = m_paclHeaps[i].m_clHeap.Alloc();
00144         }
00145         CS_EXIT();
00146
00147         // Return an object if found
00148         if (pvRet)
00149         {
00150             return pvRet;
00151         }
00152         i++;
00153     }
00154
00155     // Or null on no-match
00156     return pvRet;
00157 }
00158
00159 //---------------------------------------------------------------------------
00160 void FixedHeap::Free( void *pvNode_ )
00161 {
00162     // Compute the pointer to the block-heap this block belongs to, and
00163     // return it.
```

```
00164     CS_ENTER();
00165     BlockHeap **pclHeap = (BlockHeap**)((K_ADDR)pvNode_ - sizeof(
      BlockHeap*));
00166     (*pclHeap)->Free(pvNode_);
00167     CS_EXIT();
00168 }
00169
00170
```

14.55 /home/moslevin2/mark3/embedded/stage/src/fixed_heap.h File Reference

Fixed-block-size heaps.

```
#include "kerneltypes.h"
#include "ll.h"
```

Classes

- class BlockHeap

  Single-block-size heap.
- class HeapConfig

  Heap configuration object.
- class FixedHeap

  Fixed-size-block heap allocator with multiple block sizes.

14.55.1 Detailed Description

Fixed-block-size heaps.

Definition in file fixed_heap.h.

14.56 fixed_heap.h

```
00001 /*===========================================================================
00002      _____          _____          _____          _____
00003  ___|    _|__   __|_    |__   __|__    |__   __| __   |__   ______
00004 |    \  /   | ||     \       ||      |     ||   |/ /     ||___   |
00005 |     \/    | ||      \      ||      \     ||      \     ||___   |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00019 #ifndef __FIXED_HEAP_H__
00020 #define __FIXED_HEAP_H__
00021
00022 #include "kerneltypes.h"
00023 #include "ll.h"
00024
00025 //---------------------------------------------------------------------------
00029 class BlockHeap
00030 {
00031 public:
00046     void *Create( void *pvHeap_, K_USHORT usSize_, K_USHORT usBlockSize_ );
00047
00055     void *Alloc();
00056
00065     void Free( void* pvData_ );
00066
00074     K_BOOL IsFree() { return m_usBlocksFree != 0; }
00075
00076 protected:
00077     K_USHORT m_usBlocksFree;
```

```
00078
00079 private:
00080     DoubleLinkList m_clList;
00081 };
00082
00083
00084 class FixedHeap;
00085
00086 //---------------------------------------------------------------------------
00090 class HeapConfig
00091 {
00092 public:
00093     K_USHORT m_usBlockSize;
00094     K_USHORT m_usBlockCount;
00095     friend class FixedHeap;
00096 protected:
00097     BlockHeap m_clHeap;
00098 };
00099
00100 //---------------------------------------------------------------------------
00104 class FixedHeap
00105 {
00106 public:
00122     void Create( void *pvHeap_, HeapConfig *pclHeapConfig_ );
00123
00135     void *Alloc( K_USHORT usSize_ );
00136
00148     static void Free( void *pvNode_ );
00149
00150 private:
00151     HeapConfig *m_paclHeaps;
00152 };
00153
00154 #endif
00155
```

14.57 /home/moslevin2/mark3/embedded/stage/src/font.h File Reference

Font structure definitions.

```
#include "kerneltypes.h"
#include "fontport.h"
```

Classes

- struct Glyph_t
- struct Font_t

Macros

- #define GLYPH_SIZE(x) (((K_USHORT)((x->ucWidth + 7) >> 3) * (K_USHORT)(x->ucHeight)) + sizeof(Glyph_t) - 1)

  *The size of the glyph is the width*height (in bytes), plus the overhead of the struct parameters.*

14.57.1 Detailed Description

Font structure definitions.

Definition in file font.h.

14.58 font.h

```
00001 /*===========================================================================
00002     _____       _____       _____       _____
```

```
00003  ___|    _|__  __|_    |__  __|__   |__  __| __  |__  ______
00004 |    \  /  | ||    \      ||     |     ||  |/ /     ||___   |
00005 |     \/   | ||     \     ||     \     ||     \     ||___   |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]-----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00019 #ifndef __FONT_H__
00020 #define __FONT_H__
00021
00022 #include "kerneltypes.h"
00023 #include "fontport.h"
00024
00025 //---------------------------------------------------------------------------
00026 typedef struct
00027 {
00028     K_UCHAR ucWidth;
00029     K_UCHAR ucHeight;
00030     K_UCHAR ucVOffset;
00031     K_UCHAR aucData[1];
00032 } Glyph_t;
00033
00034 //---------------------------------------------------------------------------
00039 #define GLYPH_SIZE(x) \
00040     (((K_USHORT)((x->ucWidth + 7) >> 3) * (K_USHORT)(x->ucHeight)) + sizeof(Glyph_t) - 1)
00041
00042 //---------------------------------------------------------------------------
00043 typedef struct
00044 {
00045     K_UCHAR ucSize;
00046     K_UCHAR ucFlags;
00047     K_UCHAR ucStartChar;
00048     K_UCHAR ucMaxChar;
00049     const K_CHAR *szName;
00050     const FONT_STORAGE_TYPE *pucFontData;
00051 } Font_t;
00052
00053 #endif
00054
```

14.59 /home/moslevin2/mark3/embedded/stage/src/graphics.cpp File Reference

Generic graphics driver implementation.

```
#include "kerneltypes.h"
#include "graphics.h"
#include "draw.h"
#include "driver.h"
#include "colorspace.h"
#include "font.h"
```

14.59.1 Detailed Description

Generic graphics driver implementation.

Definition in file graphics.cpp.

14.60 graphics.cpp

```
00001 /*===========================================================================
00002      _____        _____        _____        _____
00003  ___|    _|__  __|_    |__  __|__   |__  __| __  |__  ______
00004 |    \  /  | ||    \      ||     |     ||  |/ /     ||___   |
00005 |     \/   | ||     \     ||     \     ||     \     ||___   |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|      |_____|      |_____|      |_____|
00008
```

```
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ============================================================================*/
00019 #include "kerneltypes.h"
00020 #include "graphics.h"
00021 #include "draw.h"
00022 #include "driver.h"
00023 #include "colorspace.h"
00024 #include "font.h"
00025
00026 //---------------------------------------------------------------------------
00027 void GraphicsDriver::ClearScreen()
00028 {
00029     DrawPoint_t stPoint;
00030     stPoint.uColor = COLOR_BLACK;
00031
00032     for (stPoint.usX = 0; stPoint.usX < m_usResX; stPoint.usX++)
00033     {
00034         for (stPoint.usY = 0; stPoint.usY < m_usResY; stPoint.usY++)
00035         {
00036             // Pixel Write
00037             DrawPixel(&stPoint);
00038         }
00039     }
00040 }
00041 //---------------------------------------------------------------------------
00042 void GraphicsDriver::Point(DrawPoint_t *pstPoint_)
00043 {
00044     DrawPixel(pstPoint_);
00045 }
00046
00047 //---------------------------------------------------------------------------
00048 void GraphicsDriver::Line(DrawLine_t *pstLine_)
00049 {
00050     // Bresenham Line drawing algorithm, adapted from:
00051     // www.cs.unc.edu/~mcmillan/comp136/Lecture6/Lines.html
00052
00053     DrawPoint_t stPoint;
00054     K_SHORT sX1 = (K_SHORT)pstLine_->usX1;
00055     K_SHORT sX2 = (K_SHORT)pstLine_->usX2;
00056     K_SHORT sY1 = (K_SHORT)pstLine_->usY1;
00057     K_SHORT sY2 = (K_SHORT)pstLine_->usY2;
00058     K_SHORT sDeltaY = sY2 - sY1;
00059     K_SHORT sDeltaX = sX2 - sX1;
00060     K_CHAR cStepx, cStepy;
00061     stPoint.uColor = pstLine_->uColor;
00062
00063     if (sDeltaY < 0)
00064     {
00065         sDeltaY = -sDeltaY;
00066         cStepy = -1;
00067     }
00068     else
00069     {
00070         cStepy = 1;
00071     }
00072
00073     if (sDeltaX < 0)
00074     {
00075         sDeltaX = -sDeltaX;
00076         cStepx = -1;
00077     }
00078     else
00079     {
00080         cStepx = 1;
00081     }
00082
00083     // Scale by a factor of 2 in each direction
00084     sDeltaY <<= 1;
00085     sDeltaX <<= 1;
00086
00087     stPoint.usX = sX1;
00088     stPoint.usY = sY1;
00089     DrawPixel(&stPoint);
00090
00091     if (sDeltaX > sDeltaY)
00092     {
00093         K_SHORT sFraction = sDeltaY - (sDeltaX >> 1);
00094
00095         while (sX1 != sX2)
00096         {
00097             if (sFraction >= 0)
00098             {
00099                 sY1 += cStepy;
00100                 sFraction -= sDeltaX;
```

```
00101             }
00102             sX1 += cStepx;
00103             sFraction += sDeltaY;
00104 
00105             stPoint.usX = sX1;
00106             stPoint.usY = sY1;
00107             DrawPixel(&stPoint);
00108         }
00109     }
00110     else
00111     {
00112         K_SHORT sFraction = sDeltaX - (sDeltaY >> 1);
00113         while (sY1 != sY2)
00114         {
00115             if (sFraction >= 0)
00116             {
00117                 sX1 += cStepx;
00118                 sFraction -= sDeltaY;
00119             }
00120             sY1 += cStepy;
00121             sFraction += sDeltaX;
00122 
00123             stPoint.usX = sX1;
00124             stPoint.usY = sY1;
00125             DrawPixel(&stPoint);
00126         }
00127     }
00128 }
00129 
00130 //---------------------------------------------------------------------------
00131 void GraphicsDriver::Rectangle(DrawRectangle_t *pstRectangle_)
00132 {
00133     DrawPoint_t stPoint;
00134 
00135     // if drawing a background fill color (optional)
00136     if (pstRectangle_->bFill == true)
00137     {
00138         stPoint.uColor = pstRectangle_->uFillColor;
00139         for (stPoint.usX = pstRectangle_->usLeft; stPoint.usX <= pstRectangle_->
      usRight; stPoint.usX++)
00140         {
00141             for (stPoint.usY = pstRectangle_->usTop; stPoint.usY <= pstRectangle_->
      usBottom; stPoint.usY++)
00142             {
00143                 DrawPixel(&stPoint);
00144             }
00145         }
00146     }
00147 
00148     // Draw four orthogonal lines...
00149     stPoint.uColor = pstRectangle_->uLineColor;
00150     stPoint.usY = pstRectangle_->usTop;
00151     for (stPoint.usX = pstRectangle_->usLeft; stPoint.usX <= pstRectangle_->
      usRight; stPoint.usX++)
00152     {
00153         DrawPixel(&stPoint);
00154     }
00155 
00156     stPoint.usY = pstRectangle_->usBottom;
00157     for (stPoint.usX = pstRectangle_->usLeft; stPoint.usX <= pstRectangle_->
      usRight; stPoint.usX++)
00158     {
00159         DrawPixel(&stPoint);
00160     }
00161 
00162     stPoint.usX = pstRectangle_->usLeft;
00163     for (stPoint.usY = pstRectangle_->usTop; stPoint.usY <= pstRectangle_->
      usBottom; stPoint.usY++)
00164     {
00165         DrawPixel(&stPoint);
00166     }
00167 
00168     stPoint.usX = pstRectangle_->usRight;
00169     for (stPoint.usY = pstRectangle_->usTop; stPoint.usY <= pstRectangle_->
      usBottom; stPoint.usY++)
00170     {
00171         DrawPixel(&stPoint);
00172     }
00173 }
00174 
00175 //---------------------------------------------------------------------------
00176 void GraphicsDriver::Circle(DrawCircle_t *pstCircle_)
00177 {
00178     DrawPoint_t stPoint;
00179     K_SHORT sX;
00180     K_SHORT sY;
00181     K_ULONG ulRadSquare;
```

```
00182
00183     K_ULONG ulXSquare;
00184     K_ULONG ulYSquare;
00185
00186     // Get the radius squared value...
00187     ulRadSquare = (K_ULONG)pstCircle_->usRadius;
00188     ulRadSquare *= ulRadSquare;
00189
00190     // Look at the upper-right quarter of the circle
00191     for (sX = 0; sX <= (K_SHORT)pstCircle_->usRadius; sX++)
00192     {
00193         ulXSquare = (K_ULONG)sX;
00194         ulXSquare *= ulXSquare;
00195         for (sY = 0; sY <= (K_SHORT)pstCircle_->usRadius; sY++)
00196         {
00197             ulYSquare = (K_ULONG)sY;
00198             ulYSquare *= ulYSquare;
00199
00200             // if filled...
00201             if (pstCircle_->bFill == true)
00202             {
00203                 stPoint.uColor = pstCircle_->uFillColor;
00204                 if (ulXSquare + ulYSquare <= ulRadSquare)
00205                 {
00206                     // Draw the fill color at the appropriate locations (quadrature...)
00207                     stPoint.usX = pstCircle_->usX + sX;
00208                     stPoint.usY = pstCircle_->usY + sY;
00209                     DrawPixel(&stPoint);
00210                     stPoint.usX = pstCircle_->usX - sX;
00211                     stPoint.usY = pstCircle_->usY + sY;
00212                     DrawPixel(&stPoint);
00213                     stPoint.usX = pstCircle_->usX + sX;
00214                     stPoint.usY = pstCircle_->usY - sY;
00215                     DrawPixel(&stPoint);
00216                     stPoint.usX = pstCircle_->usX - sX;
00217                     stPoint.usY = pstCircle_->usY - sY;
00218                     DrawPixel(&stPoint);
00219                 }
00220             }
00221             // Check for edge...
00222             if (
00223                 ((ulXSquare + ulYSquare) >= (ulRadSquare-pstCircle_->usRadius)) &&
00224                 ((ulXSquare + ulYSquare) <= (ulRadSquare+pstCircle_->usRadius))
00225                )
00226             {
00227                 stPoint.uColor = pstCircle_->uLineColor;
00228
00229                 // Draw the fill color at the appropriate locations (quadrature...)
00230                 stPoint.usX = pstCircle_->usX + sX;
00231                 stPoint.usY = pstCircle_->usY + sY;
00232                 DrawPixel(&stPoint);
00233                 stPoint.usX = pstCircle_->usX - sX;
00234                 stPoint.usY = pstCircle_->usY + sY;
00235                 DrawPixel(&stPoint);
00236                 stPoint.usX = pstCircle_->usX + sX;
00237                 stPoint.usY = pstCircle_->usY - sY;
00238                 DrawPixel(&stPoint);
00239                 stPoint.usX = pstCircle_->usX - sX;
00240                 stPoint.usY = pstCircle_->usY - sY;
00241                 DrawPixel(&stPoint);
00242             }
00243         }
00244     }
00245 }
00246
00247 //---------------------------------------------------------------------------
00248 void GraphicsDriver::Ellipse(DrawEllipse_t *pstEllipse_)
00249 {
00250     DrawPoint_t stPoint;
00251     K_SHORT sX;
00252     K_SHORT sY;
00253     K_ULONG ulRadius;
00254     K_ULONG ulHSquare;
00255     K_ULONG ulVSquare;
00256     K_ULONG ulXSquare;
00257     K_ULONG ulYSquare;
00258
00259     ulHSquare = (K_ULONG)pstEllipse_->usWidth;
00260     ulHSquare *= ulHSquare;
00261
00262     ulVSquare = (K_ULONG)pstEllipse_->usHeight;
00263     ulVSquare *= ulVSquare;
00264
00265     ulRadius = ulHSquare * ulVSquare;
00266
00267     for (sX = 0; sX <= (K_SHORT)pstEllipse_->usWidth; sX++)
00268     {
```

```
00269         ulXSquare = (K_ULONG)sX;
00270         ulXSquare *= ulXSquare;
00271         ulXSquare *= ulHSquare;
00272 
00273         for (sY = 0; sY <= (K_SHORT)pstEllipse_->usHeight; sY++)
00274         {
00275             ulYSquare = (K_ULONG)sY;
00276             ulYSquare *= ulYSquare;
00277             ulYSquare *= ulVSquare;
00278 
00279             if ((ulXSquare + ulYSquare) <= ulRadius)
00280             {
00281                 // Draw the fill color at the appropriate locations (quadrature...)
00282                 stPoint.usX = pstEllipse_->usX + sX;
00283                 stPoint.usY = pstEllipse_->usY + sY;
00284                 DrawPixel(&stPoint);
00285                 stPoint.usX = pstEllipse_->usX - sX;
00286                 stPoint.usY = pstEllipse_->usY + sY;
00287                 DrawPixel(&stPoint);
00288                 stPoint.usX = pstEllipse_->usX + sX;
00289                 stPoint.usY = pstEllipse_->usY - sY;
00290                 DrawPixel(&stPoint);
00291                 stPoint.usX = pstEllipse_->usX - sX;
00292                 stPoint.usY = pstEllipse_->usY - sY;
00293                 DrawPixel(&stPoint);
00294             }
00295         }
00296     }
00297 }
00298 
00299 //---------------------------------------------------------------------------
00300 void GraphicsDriver::Bitmap(DrawBitmap_t *pstBitmap_)
00301 {
00302     K_USHORT usRow;
00303     K_USHORT usCol;
00304 
00305     K_USHORT usIndex;
00306 
00307     K_UCHAR ucRed = 0;
00308     K_UCHAR ucBlue = 0;
00309     K_UCHAR ucGreen = 0;
00310 
00311     DrawPoint_t stPoint;
00312 
00313     usIndex = 0;
00314     for (usRow = pstBitmap_->usY; usRow < (pstBitmap_->usY + pstBitmap_->
      usHeight); usRow++)
00315     {
00316         for (usCol = pstBitmap_->usX; usCol < (pstBitmap_->usX + pstBitmap_->
      usWidth); usCol++)
00317         {
00318 
00319             stPoint.usX = usCol;
00320             stPoint.usY = usRow;
00321 
00322             // Build the color based on the bitmap value...  This algorithm
00323             // is slow, but it automatically converts any 8/16/24 bit bitmap into the
00324             // current colorspace defined...
00325             switch(pstBitmap_->ucBPP)
00326             {
00327                 case 1:
00328                 {
00329                     // 3:2:3, RGB
00330                     ucRed     = ((pstBitmap_->pucData[usIndex]) & 0xE0) << 1;
00331                     ucGreen   = ((pstBitmap_->pucData[usIndex]) & 0x18) << 3;
00332                     ucBlue    = ((pstBitmap_->pucData[usIndex]) & 0x07) << 5;
00333                 }
00334                     break;
00335                 case 2:
00336                 {
00337                     K_USHORT usTemp;
00338                     usTemp = pstBitmap_->pucData[usIndex];
00339                     usTemp <<= 8;
00340                     usTemp |= pstBitmap_->pucData[usIndex + 1];
00341 
00342                     // 5:6:5, RGB
00343                     ucRed     = (K_UCHAR)((usTemp >> 11) & 0x001F) << 3;
00344                     ucGreen   = (K_UCHAR)((usTemp >> 5) & 0x003F)  << 2;
00345                     ucBlue    = (K_UCHAR)(usTemp & 0x001F) << 3;
00346                 }
00347                     break;
00348                 case 3:
00349                 {
00350                     K_ULONG ulTemp;
00351                     ulTemp = pstBitmap_->pucData[usIndex];
00352                     ulTemp <<= 8;
00353                     ulTemp |= pstBitmap_->pucData[usIndex + 1];
```

```
00354                     ulTemp <<= 8;
00355                     ulTemp |= pstBitmap_->pucData[usIndex + 2];
00356 
00357                     // 8:8:8 RGB
00358                     ucRed    = (K_UCHAR)((ulTemp & 0x00FF0000) >> 16);
00359                     ucGreen  = (K_UCHAR)((ulTemp & 0x0000FF00) >> 8);
00360                     ucBlue   = (K_UCHAR)((ulTemp & 0x000000FF));
00361                 }
00362                     break;
00363                 default:
00364                     break;
00365             }
00366 
00367             // Convert the R,G,B values into the correct colorspace for display
00368 #if DRAW_COLOR_2BIT
00369             //1-bit
00370             ucRed >>= 7;
00371             ucGreen >>= 7;
00372             ucBlue >>= 7;
00373 #elif DRAW_COLOR_8BIT
00374             //3:2:3 R:G:B
00375             ucRed >>= 5;
00376             ucGreen >>= 6;
00377             ucBlue >>= 5;
00378 #elif DRAW_COLOR_16BIT
00379             //5:6:5 R:G:B
00380             ucRed >>= 3;
00381             ucGreen >>= 2;
00382             ucBlue >>= 3;
00383 #elif DRAW_COLOR_24BIT
00384             // No conversion required
00385 #endif
00386             // Build the color.
00387             stPoint.uColor = RGB_COLOR(ucRed,ucGreen,ucBlue);
00388 
00389             // Draw the point.
00390             DrawPixel(&stPoint);
00391 
00392             // Stamps are opaque, don't fill in the BG
00393             usIndex += m_ucBPP / 8;
00394         }
00395     }
00396 }
00397 
00398 //-------------------------------------------------------------------------
00399 void GraphicsDriver::Stamp(DrawStamp_t *pstStamp_)
00400 {
00401     K_USHORT usRow;
00402     K_USHORT usCol;
00403     K_USHORT usShift;
00404     K_USHORT usIndex;
00405     DrawPoint_t stPoint;
00406 
00407     usIndex = 0;
00408     for (usRow = pstStamp_->usY; usRow < (pstStamp_->usY + pstStamp_->
    usHeight); usRow++)
00409     {
00410         usShift = 0x80;
00411         for (usCol = pstStamp_->usX; usCol < (pstStamp_->usX + pstStamp_->
    usWidth); usCol++)
00412         {
00413             // If the packed bit in the bitmap is a "1", draw the color.
00414             if (pstStamp_->pucData[usIndex] & usShift)
00415             {
00416                 stPoint.usX = usCol;
00417                 stPoint.usY = usRow;
00418                 stPoint.uColor = pstStamp_->uColor;
00419                 DrawPixel(&stPoint);
00420             }
00421             // Stamps are opaque, don't fill in the BG
00422 
00423             // Shift to the next bit in the field
00424             usShift >>= 1;
00425 
00426             // Rollover - next bit in the bitmap.
00427             // This obviously works best for stamps that are multiples of 8x8
00428             if (usShift == 0)
00429             {
00430                 usShift = 0x80;
00431                 usIndex++;
00432             }
00433         }
00434     }
00435 }
00436 
00437 //-------------------------------------------------------------------------
00438 void GraphicsDriver::Move( DrawMove_t *pstMove_ )
```

```
00439 {
00440     DrawPoint_t stPoint;
00441     K_LONG sX;
00442     K_LONG sY;
00443     K_LONG sXInc = 0;
00444     K_LONG sYInc = 0;
00445 
00446     K_BOOL bLeftToRight = false;
00447     K_BOOL bTopToBottom = false;
00448 
00449     if (pstMove_->usSrcX > pstMove_->usDstX)
00450     {
00451         bLeftToRight = true;
00452     }
00453     if (pstMove_->usSrcY > pstMove_->usDstY)
00454     {
00455         bTopToBottom = true;
00456     }
00457 
00458     if (bLeftToRight)
00459     {
00460         sXInc++;
00461     }
00462     else
00463     {
00464         sXInc--;
00465         pstMove_->usSrcX += pstMove_->usCopyWidth - 1;
00466         pstMove_->usDstX += pstMove_->usCopyWidth - 1;
00467     }
00468 
00469     if (bTopToBottom)
00470     {
00471         sYInc++;
00472     }
00473     else
00474     {
00475         sYInc--;
00476         pstMove_->usSrcY += pstMove_->usCopyHeight - 1;
00477         pstMove_->usDstY += pstMove_->usCopyHeight - 1;
00478     }
00479 
00480     // Hideously inefficient memory move...
00481     for (sX = 0; sX < pstMove_->usCopyWidth; sX++)
00482     {
00483         for (sY = 0; sY < pstMove_->usCopyHeight; sY++)
00484         {
00485             // Read from source (value read into the point struct)
00486             stPoint.usY = (K_USHORT)((K_LONG)pstMove_->usSrcY + ((K_LONG)sY * sYInc));
00487             stPoint.usX = (K_USHORT)((K_LONG)pstMove_->usSrcX + ((K_LONG)sX * sXInc));
00488             ReadPixel(&stPoint);
00489 
00490             // Copy to dest
00491             stPoint.usY = (K_USHORT)((K_LONG)pstMove_->usDstY + ((K_LONG)sY * sYInc));
00492             stPoint.usX = (K_USHORT)((K_LONG)pstMove_->usDstX + ((K_LONG)sX * sXInc));
00493             DrawPixel(&stPoint);
00494         }
00495     }
00496 }
00497 
00498 //---------------------------------------------------------------------------
00499 void GraphicsDriver::Text(DrawText_t *pstText_)
00500 {
00501     K_USHORT usX, usY;
00502     K_USHORT usStartX;
00503     K_USHORT usStartY;
00504     K_USHORT usCharOffsetX;
00505     K_USHORT usCharIndex = 0;
00506     K_UCHAR *pucData = (K_UCHAR*)pstText_->pstFont->pucFontData;
00507     DrawPoint_t stPoint;
00508 
00509     // set the color for this element.
00510     stPoint.uColor = pstText_->uColor;
00511 
00512     usCharOffsetX = 0;
00513 
00514     // Draw every character in the string, one at a time
00515     while (pstText_->pcString[usCharIndex] != 0)
00516     {
00517         K_USHORT usOffset = 0;
00518 
00519         K_UCHAR ucWidth;
00520         K_UCHAR ucHeight;
00521         K_UCHAR ucVOffset;
00522         K_UCHAR ucBitmask;
00523 
00524         // Read the glyphs from memory until we arrive at the one we wish to print
00525         for (usX = 0; usX < pstText_->pcString[usCharIndex]; usX++)
```

```
00526         {
00527             // Glyphs are variable-sized for efficiency - to look up a particular
00528             // glyph, we must traverse all preceding glyphs in the list
00529             ucWidth  = Font_ReadByte(usOffset, pucData);
00530             ucHeight = Font_ReadByte(usOffset + 1, pucData);
00531 
00532             // Adjust the offset to point to the next glyph
00533             usOffset += ((((K_USHORT)ucWidth + 7) >> 3) * (K_USHORT)ucHeight)
00534                         + (sizeof(Glyph_t) - 1);
00535         }
00536 
00537         // Header information:  glyph size and vertical offset
00538         ucWidth   = Font_ReadByte(usOffset++, pucData);
00539         ucHeight  = Font_ReadByte(usOffset++, pucData);
00540         ucVOffset = Font_ReadByte(usOffset++, pucData);
00541 
00542         usStartY = pstText_->usTop + (K_USHORT)ucVOffset;
00543         usStartX = pstText_->usLeft;
00544 
00545         // Draw the font from left->right, top->bottom
00546         for (   usY = usStartY;
00547                 usY < usStartY + (K_USHORT)ucHeight;
00548                 usY++ )
00549         {
00550             K_UCHAR ucTempChar = Font_ReadByte(usOffset, pucData);
00551             ucBitmask = 0x80;
00552 
00553             for (   usX = usCharOffsetX + usStartX;
00554                     usX < usCharOffsetX + usStartX + (K_USHORT)ucWidth;
00555                     usX++ )
00556             {
00557                 if (!ucBitmask)
00558                 {
00559                     ucBitmask = 0x80;
00560                     usOffset++;
00561                     ucTempChar = Font_ReadByte(usOffset, pucData);
00562                 }
00563 
00564                 if (ucTempChar & ucBitmask)
00565                 {
00566                     // Update the location
00567                     stPoint.usX = usX;
00568                     stPoint.usY = usY;
00569 
00570                     // Draw the point.
00571                     DrawPixel(&stPoint);
00572                 }
00573 
00574                 ucBitmask >>= 1;
00575             }
00576 
00577             usOffset++;
00578         }
00579 
00580         // Next character
00581         usCharIndex++;
00582         usCharOffsetX += (K_USHORT)ucWidth + 1;
00583     }
00584 }
00585 
00586 //---------------------------------------------------------------------------
00587 K_USHORT GraphicsDriver::TextWidth(DrawText_t *pstText_)
00588 {
00589     K_USHORT usCharOffsetX;
00590     K_USHORT usCharIndex = 0;
00591     K_USHORT usX;
00592     K_UCHAR *pucData = (K_UCHAR*)pstText_->pstFont->pucFontData;
00593 
00594     usCharOffsetX = 0;
00595 
00596     // Draw every character in the string, one at a time
00597     while (pstText_->pcString[usCharIndex] != 0)
00598     {
00599         K_USHORT usOffset = 0;
00600 
00601         K_UCHAR ucWidth;
00602         K_UCHAR ucHeight;
00603 
00604         // Read the glyphs from memory until we arrive at the one we wish to print
00605         for (usX = 0; usX < pstText_->pcString[usCharIndex]; usX++)
00606         {
00607             // Glyphs are variable-sized for efficiency - to look up a particular
00608             // glyph, we must traverse all preceding glyphs in the list
00609             ucWidth  = Font_ReadByte(usOffset, pucData);
00610             ucHeight = Font_ReadByte(usOffset + 1, pucData);
00611 
00612             // Adjust the offset to point to the next glyph
```

```
00613             usOffset += ((((K_USHORT)ucWidth + 7) >> 3) * (K_USHORT)ucHeight)
00614                         + (sizeof(Glyph_t) - 1);
00615         }
00616 
00617         // Header information:  glyph size and vertical offset
00618         ucWidth   = Font_ReadByte(usOffset, pucData);
00619         usOffset += (sizeof(Glyph_t) - 1);
00620 
00621         // Next character
00622         usCharIndex++;
00623         usCharOffsetX += (K_USHORT)ucWidth + 1;
00624     }
00625 
00626     return usCharOffsetX;
00627 }
00628 
00629 //---------------------------------------------------------------------------
00630 void GraphicsDriver::TriangleWire(DrawPoly_t *pstPoly_)
00631 {
00632     DrawLine_t stLine;
00633 
00634     stLine.uColor = pstPoly_->uColor;
00635 
00636     stLine.usX1 = pstPoly_->pstVector[0].usX;
00637     stLine.usY1 = pstPoly_->pstVector[0].usY;
00638     stLine.usX2 = pstPoly_->pstVector[1].usX;
00639     stLine.usY2 = pstPoly_->pstVector[1].usY;
00640     Line(&stLine);
00641 
00642     stLine.usX1 = pstPoly_->pstVector[1].usX;
00643     stLine.usY1 = pstPoly_->pstVector[1].usY;
00644     stLine.usX2 = pstPoly_->pstVector[2].usX;
00645     stLine.usY2 = pstPoly_->pstVector[2].usY;
00646     Line(&stLine);
00647 
00648     stLine.usX1 = pstPoly_->pstVector[2].usX;
00649     stLine.usY1 = pstPoly_->pstVector[2].usY;
00650     stLine.usX2 = pstPoly_->pstVector[0].usX;
00651     stLine.usY2 = pstPoly_->pstVector[0].usY;
00652     Line(&stLine);
00653 }
00654 //---------------------------------------------------------------------------
00655 void GraphicsDriver::TriangleFill(DrawPoly_t *pstPoly_)
00656 {
00657     // Drawing a raster-filled triangle:
00658     K_UCHAR ucMaxEdge = 0;
00659     K_UCHAR ucMinEdge1 = 0, ucMinEdge2 = 0;
00660     K_SHORT sMax = 0;
00661     K_SHORT sTemp;
00662 
00663     K_SHORT sDeltaX1, sDeltaX2;
00664     K_SHORT sDeltaY1, sDeltaY2;
00665     K_CHAR cStepX1, cStepX2;
00666     K_CHAR cStepY;
00667     K_SHORT sX1, sX2, sX3, sY1, sY2, sY3;
00668     K_SHORT sTempX1, sTempY1, sTempX2, sTempY2;
00669     K_SHORT sFraction1;
00670     K_SHORT sFraction2;
00671     K_SHORT i;
00672     DrawPoint_t stPoint;
00673 
00674     // Figure out which line segment is the longest
00675     sTemp = (K_SHORT)pstPoly_->pstVector[0].usY - (K_SHORT)pstPoly_->
      pstVector[1].usY;
00676     if( sTemp < 0 )     { sTemp = -sTemp; }
00677     if( sTemp > sMax ) { sMax  = sTemp; ucMaxEdge = 0; ucMinEdge1 = 1; ucMinEdge2 = 2;}
00678 
00679     sTemp = (K_SHORT)pstPoly_->pstVector[1].usY - (K_SHORT)pstPoly_->
      pstVector[2].usY;
00680     if( sTemp < 0 )     { sTemp = -sTemp; }
00681     if( sTemp > sMax ) { sMax  = sTemp; ucMaxEdge = 1; ucMinEdge1 = 2; ucMinEdge2 = 0; }
00682 
00683     sTemp = (K_SHORT)pstPoly_->pstVector[2].usY - (K_SHORT)pstPoly_->
      pstVector[0].usY;
00684     if( sTemp < 0 )     { sTemp = -sTemp; }
00685     if( sTemp > sMax ) { sMax  = sTemp; ucMaxEdge = 2; ucMinEdge1 = 0; ucMinEdge2 = 1;}
00686 
00687     // Label the vectors and copy into temporary signed buffers
00688     sX1 = (K_SHORT)pstPoly_->pstVector[ucMaxEdge].usX;
00689     sX2 = (K_SHORT)pstPoly_->pstVector[ucMinEdge1].usX;
00690     sX3 = (K_SHORT)pstPoly_->pstVector[ucMinEdge2].usX;
00691 
00692     sY1 = (K_SHORT)pstPoly_->pstVector[ucMaxEdge].usY;
00693     sY2 = (K_SHORT)pstPoly_->pstVector[ucMinEdge1].usY;
00694     sY3 = (K_SHORT)pstPoly_->pstVector[ucMinEdge2].usY;
00695 
00696     // Figure out whether or not we're drawing up-down or down-up
```

```
00697     sDeltaY1 = sY1 - sY2;
00698     if (sDeltaY1 < 0) { cStepY = -1; sDeltaY1 = -sDeltaY1; } else { cStepY = 1; }
00699
00700     sDeltaX1 = sX1 - sX2;
00701     if (sDeltaX1 < 0) { cStepX1 = -1; sDeltaX1 = -sDeltaX1; } else { cStepX1 = 1; }
00702
00703     sDeltaY2 = sY1 - sY3;
00704     if (sDeltaY2 < 0) { cStepY = -1; sDeltaY2 = -sDeltaY2; } else { cStepY = 1; }
00705
00706     sDeltaX2 = sX1 - sX3;
00707     if (sDeltaX2 < 0) { cStepX2 = -1; sDeltaX2 = -sDeltaX2; } else { cStepX2 = 1; }
00708
00709     sDeltaX1 <<=1;
00710     sDeltaX2 <<=1;
00711     sDeltaY1 <<=1;
00712     sDeltaY2 <<=1;
00713
00714     sFraction1 = sDeltaX1;// - (sDeltaY1 >> 1);
00715     sFraction2 = sDeltaX2;// - (sDeltaY2 >> 1);
00716
00717     sTempY1 = sY1;
00718     sTempY2 = sY1;
00719     sTempX1 = sX1;
00720     sTempX2 = sX1;
00721
00722     stPoint.uColor = pstPoly_->uColor;
00723
00724     if( sDeltaY2 != 0 )
00725     {
00726         while (sTempY2 != sY3)
00727         {
00728             stPoint.usY = sTempY2;
00729             if( sTempX1 < sTempX2 ) {
00730                 for( i = sTempX1; i <= sTempX2; i++) {
00731                     stPoint.usX = i;
00732                     Point(&stPoint);
00733                 }
00734             } else {
00735                 for( i = sTempX2; i <= sTempX1; i++ ) {
00736                     stPoint.usX = i;
00737                     Point(&stPoint);
00738                 }
00739             }
00740
00741             while (sFraction2 >= sDeltaY2)
00742             {
00743                 sTempX2 -= cStepX2;
00744                 sFraction2 -= sDeltaY2;
00745             }
00746             sTempY2 -= cStepY;
00747             sFraction2 += sDeltaX2;
00748
00749             while (sFraction1 >= sDeltaY1)
00750             {
00751                 sTempX1 -= cStepX1;
00752                 sFraction1 -= sDeltaY1;
00753             }
00754             sTempY1 -= cStepY;
00755             sFraction1 += sDeltaX1;
00756         }
00757     }
00758
00759     sDeltaY2 = sY3 - sY2;
00760     sDeltaX2 = sX3 - sX2;
00761
00762     if (sDeltaX2 < 0) { cStepX2 = -1; sDeltaX2 = -sDeltaX2; } else { cStepX2 = 1; }
00763     if (sDeltaY2 < 0) { cStepY = -1;  sDeltaY2 = -sDeltaY2; } else { cStepY  = 1; }
00764
00765     sDeltaX2 <<=1;
00766     sDeltaY2 <<=1;
00767
00768     sFraction2 = sDeltaX2; // - (sDeltaY2 >> 1);
00769
00770     sTempY2 = sY3;
00771     sTempX2 = sX3;
00772
00773     if( sDeltaY2 != 0)
00774     {
00775         while (sTempY2 != sY2)
00776         {
00777             stPoint.usY = sTempY2;
00778             if( sTempX1 < sTempX2 ) {
00779                 for( i = sTempX1; i <= sTempX2; i++) {
00780                     stPoint.usX = i;
00781                     Point(&stPoint);
00782                 }
00783             } else {
```

```
00784                 for( i = sTempX2; i <= sTempX1; i++ ) {
00785                     stPoint.usX = i;
00786                     Point(&stPoint);
00787                 }
00788             }
00789 
00790             while (sFraction2 >= sDeltaY2)
00791             {
00792                 sTempX2 -= cStepX2;
00793                 sFraction2 -= sDeltaY2;
00794             }
00795             sTempY2 -= cStepY;
00796             sFraction2 += sDeltaX2;
00797 
00798             while (sFraction1 >= sDeltaY1)
00799             {
00800                 sTempX1 -= cStepX1;
00801                 sFraction1 -= sDeltaY1;
00802             }
00803             sTempY1 -= cStepY;
00804             sFraction1 += sDeltaX1;
00805         }
00806     }
00807 }
00808 
00809 //-----------------------------------------------------------------------------
00810 void GraphicsDriver::Polygon(DrawPoly_t *pstPoly_)
00811 {
00812     K_USHORT i,j,k;
00813     K_BOOL bState = false;
00814 
00815     DrawPoly_t   stTempPoly;
00816     DrawVector_t astTempVec[3];
00817 
00818     if (pstPoly_->usNumPoints < 3)
00819     {
00820         return;
00821     }
00822 
00823     stTempPoly.uColor = pstPoly_->uColor;
00824     stTempPoly.bFill = pstPoly_->bFill;
00825     stTempPoly.pstVector = astTempVec;
00826     stTempPoly.usNumPoints = 3;
00827 
00828     astTempVec[0].usX = pstPoly_->pstVector[0].usX;
00829     astTempVec[1].usX = pstPoly_->pstVector[1].usX;
00830     astTempVec[0].usY = pstPoly_->pstVector[0].usY;
00831     astTempVec[1].usY = pstPoly_->pstVector[1].usY;
00832 
00833     j = 2;
00834     astTempVec[2].usX = pstPoly_->pstVector[pstPoly_->usNumPoints - 1].usX;
00835     astTempVec[2].usY = pstPoly_->pstVector[pstPoly_->usNumPoints - 1].usY;
00836 
00837     k = pstPoly_->usNumPoints - 2;
00838 
00839     if( pstPoly_->bFill )
00840     {
00841         TriangleFill(&stTempPoly);
00842     }
00843     else
00844     {
00845         TriangleWire(&stTempPoly);
00846     }
00847 
00848     // Filled polygon/wireframe polygon using triangle decomp.
00849     for(i = 0; i < pstPoly_->usNumPoints - 3; i++)
00850     {
00851         astTempVec[0].usX = astTempVec[1].usX;
00852         astTempVec[1].usX = astTempVec[2].usX;
00853         astTempVec[0].usY = astTempVec[1].usY;
00854         astTempVec[1].usY = astTempVec[2].usY;
00855 
00856         if( !bState )
00857         {
00858             bState = true;
00859             astTempVec[2].usX = pstPoly_->pstVector[j].usX;
00860             astTempVec[2].usY = pstPoly_->pstVector[j].usY;
00861             j++;
00862         }
00863         else
00864         {
00865             bState = false;
00866             astTempVec[2].usX = pstPoly_->pstVector[k].usX;
00867             astTempVec[2].usY = pstPoly_->pstVector[k].usY;
00868             k--;
00869         }
00870         if( pstPoly_->bFill )
```

```
00871         {
00872             TriangleFill(&stTempPoly);
00873         }
00874         else
00875         {
00876             TriangleWire(&stTempPoly);
00877         }
00878     }
00879 }
00880
00881 //---------------------------------------------------------------------------
00882 void GraphicsDriver::SetWindow(DrawWindow_t *pstWindow_)
00883 {
00884     if ((pstWindow_->usLeft <= pstWindow_->usRight) &&
00885         (pstWindow_->usRight < m_usResX) &&
00886         (pstWindow_->usLeft < m_usResX))
00887     {
00888         m_usLeft = pstWindow_->usLeft;
00889         m_usRight = pstWindow_->usRight;
00890     }
00891
00892     if ((pstWindow_->usTop <= pstWindow_->usBottom) &&
00893         (pstWindow_->usTop < m_usTop)  &&
00894         (pstWindow_->usBottom < m_usBottom))
00895     {
00896         m_usTop = pstWindow_->usTop;
00897         m_usBottom = pstWindow_->usBottom;
00898     }
00899
00900 }
00901
00902 //---------------------------------------------------------------------------
00903 void GraphicsDriver::ClearWindow()
00904 {
00905     m_usLeft = 0;
00906     m_usTop = 0;
00907     m_usRight = m_usResX - 1;
00908     m_usBottom = m_usResY - 1;
00909 }
```

14.61 /home/moslevin2/mark3/embedded/stage/src/graphics.h File Reference

Graphics driver class declaration.

```
#include "driver.h"
#include "draw.h"
```

Classes

- class GraphicsDriver

  Defines the base graphics driver class, which is inherited by all other graphics drivers.

14.61.1 Detailed Description

Graphics driver class declaration.

Definition in file graphics.h.

14.62 graphics.h

```
00001 /*===========================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__   ___|_    |__   ___|__    |__   ___| __   |__  _______
00004 |    \  /   | ||    \       ||      |      ||  |/ /      ||___    |
00005 |     \/    | ||     \      ||      \      ||     \      ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||_______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]-----------------------------------------------
```

```
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00019 #ifndef __GRAPHICSX_H__
00020 #define __GRAPHICSX_H__
00021
00022 #include "driver.h"
00023 #include "draw.h"
00024
00025 //---------------------------------------------------------------------------
00032 class GraphicsDriver : public Driver
00033 {
00034 public:
00035 //---------------------------------------------------------------------------
00036 /*
00037     The base graphics driver does not implement the set of
00038     virtual methods inherited from the Driver class.  This
00039     is left to the actual hardware implementation.
00040 */
00041 //---------------------------------------------------------------------------
00042
00049     virtual void DrawPixel(DrawPoint_t *pstPoint_) {};
00050
00058     virtual void ReadPixel(DrawPoint_t *pstPoint_) {};
00059
00060 //---------------------------------------------------------------------------
00061 /*
00062     Raster operations defined using per-pixel rendering.
00063     Can be overridden in inheriting classes.
00064 */
00065 //---------------------------------------------------------------------------
00071     virtual void ClearScreen();
00072
00078     virtual void Point(DrawPoint_t *pstPoint_);
00079
00085     virtual void Line(DrawLine_t *pstLine_);
00086
00092     virtual void Rectangle(DrawRectangle_t *pstRectangle_);
00093
00099     virtual void Circle(DrawCircle_t *pstCircle_);
00100
00106     virtual void Ellipse(DrawEllipse_t *pstEllipse_);
00107
00113     virtual void Bitmap(DrawBitmap_t *pstBitmap_);
00114
00120     virtual void Stamp(DrawStamp_t *pstStamp_);
00121
00131     virtual void Move(DrawMove_t *pstMove_ );
00132
00138     virtual void TriangleWire(DrawPoly_t *pstPoly_);
00139
00145     virtual void TriangleFill(DrawPoly_t *pstPoly_);
00146
00152     virtual void Polygon(DrawPoly_t *pstPoly_);
00153
00159     virtual void Text(DrawText_t *pstText_);
00160
00167     virtual K_USHORT TextWidth(DrawText_t *pstText_);
00168
00174     void SetWindow( DrawWindow_t *pstWindow_ );
00175
00181     void ClearWindow();
00182 protected:
00183
00184     K_USHORT m_usResX;
00185     K_USHORT m_usResY;
00186
00187     K_USHORT m_usLeft;
00188     K_USHORT m_usTop;
00189     K_USHORT m_usRight;
00190     K_USHORT m_usBottom;
00191
00192     K_UCHAR m_ucBPP;
00193 };
00194
00195 #endif
00196
```

14.63 /home/moslevin2/mark3/embedded/stage/src/gui.cpp File Reference

Graphical User Interface classes and data structure definitions.

```
#include "message.h"
#include "kerneltypes.h"
#include "gui.h"
#include "system_heap.h"
#include "fixed_heap.h"
#include "memutil.h"
```

14.63.1 Detailed Description

Graphical User Interface classes and data structure definitions.

Definition in file gui.cpp.

14.64 gui.cpp

```
00001 /*=====================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__   ____|_    |__   ____|__    |__   ____| __   |__   ______
00004 |    \   /   | ||     \       ||       |      ||   |/ /      ||___    |
00005 |     \/    | ||      \      ||       \      ||      \      ||___    |
00006 |__/\__/|__|_||__|\__\   __||__|\__\   __||__|\__\   __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===================================================================== */
00019 #include "message.h"
00020 #include "kerneltypes.h"
00021 #include "gui.h"
00022 #include "system_heap.h"
00023 #include "fixed_heap.h"
00024 #include "memutil.h"
00025
00026 //---------------------------------------------------------------------------
00027 void GuiWindow::AddControl( GuiControl *pclControl_,
      GuiControl *pclParent_ )
00028 {
00029     GUI_DEBUG_PRINT("GuiWindow::AddControl\n");
00030
00031     m_clControlList.Add(static_cast<LinkListNode*>(pclControl_));
00032     m_pclInFocus = pclControl_;
00033     m_ucControlCount++;
00034
00035     pclControl_->SetParentWindow(this);
00036     pclControl_->SetParentControl(pclParent_);
00037 }
00038
00039 //---------------------------------------------------------------------------
00040 void GuiWindow::RemoveControl( GuiControl *pclControl_ )
00041 {
00042     GUI_DEBUG_PRINT("GuiWindow::RemoveControl\n");
00043
00044     if (pclControl_->GetPrev())
00045     {
00046         m_pclInFocus = static_cast<GuiControl*>(pclControl_->
      GetPrev());
00047     }
00048     else if (pclControl_->GetNext())
00049     {
00050         m_pclInFocus = static_cast<GuiControl*>(pclControl_->
      GetNext());
00051     }
00052     else
00053     {
00054         m_pclInFocus = NULL;
00055     }
00056     m_clControlList.Remove(static_cast<LinkListNode*>(pclControl_));
00057     m_ucControlCount--;
00058 }
00059
00060 //---------------------------------------------------------------------------
00061 K_UCHAR GuiWindow::GetMaxZOrder()
00062 {
```

```
00063     GUI_DEBUG_PRINT("GuiWindow::GetMaxZOrder\n");
00064
00065     LinkListNode *pclTempNode;
00066     K_UCHAR ucZ = 0;
00067     K_UCHAR ucTempZ;
00068
00069     pclTempNode = m_clControlList.GetHead();
00070
00071     while (pclTempNode)
00072     {
00073         ucTempZ = (static_cast<GuiControl*>(pclTempNode))->GetZOrder();
00074         if (ucTempZ > ucZ)
00075         {
00076             ucZ = ucTempZ;
00077         }
00078         pclTempNode = pclTempNode->GetNext();
00079     }
00080
00081     return ucZ;
00082 }
00083
00084 //---------------------------------------------------------------------------
00085 void GuiWindow::Redraw( K_BOOL bRedrawAll_ )
00086 {
00087     GUI_DEBUG_PRINT("GuiWindow::Redraw\n");
00088
00089     K_UCHAR ucControlsLeft = m_ucControlCount;
00090     K_UCHAR ucCurrentZ = 0;
00091     K_UCHAR ucMaxZ;
00092
00093     ucMaxZ = GetMaxZOrder();
00094
00095     // While there are still controls left to process (and we're less than
00096     // the maximum Z-order, just a sanity check.), redraw each object that
00097     // has its stale flag set, or all controls if the bRedrawAll_ parameter
00098     // is true.
00099     while (ucControlsLeft && (ucCurrentZ <= ucMaxZ))
00100     {
00101         LinkListNode *pclTempNode;
00102
00103         pclTempNode = m_clControlList.GetHead();
00104         while (pclTempNode)
00105         {
00106             GuiControl* pclTempControl = static_cast<GuiControl*>(pclTempNode);
00107             if (pclTempControl->GetZOrder() == ucCurrentZ)
00108             {
00109                 if ((bRedrawAll_) || (pclTempControl->IsStale()))
00110                 {
00111                     pclTempControl->Draw();
00112                     pclTempControl->ClearStale();
00113                 }
00114
00115                 ucControlsLeft--;
00116             }
00117
00118             pclTempNode = pclTempNode->GetNext();
00119         }
00120         ucCurrentZ++;
00121     }
00122     GUI_DEBUG_PRINT("  Current Z: %d\n", ucCurrentZ);
00123     GUI_DEBUG_PRINT("  Controls Left: %d\n", ucControlsLeft);
00124 }
00125
00126 //---------------------------------------------------------------------------
00127 void GuiWindow::InvalidateRegion( K_USHORT usLeft_, K_USHORT usTop_, K_USHORT
      usWidth_, K_USHORT usHeight_ )
00128 {
00129     LinkListNode *pclTempNode;
00130     K_USHORT usLeft1, usLeft2, usRight1, usRight2, usTop1, usTop2, usBottom1, usBottom2;
00131
00132     pclTempNode = m_clControlList.GetHead();
00133
00134     usLeft1 = usLeft_;
00135     usRight1 = usLeft_ + usWidth_ - 1;
00136     usTop1 = usTop_;
00137     usBottom1 = usTop_ + usHeight_ - 1;
00138
00139     while (pclTempNode)
00140     {
00141         GuiControl *pclControl = static_cast<GuiControl*>(pclTempNode);
00142         K_USHORT usX, usY;
00143
00144         bool bMatch = false;
00145
00146         // Get the absolute display coordinates
00147         pclControl->GetControlOffset(&usX, &usY);
00148
```

```
00149
00150         usLeft2 = pclControl->GetLeft() + usX;
00151         usRight2 = usLeft2 + pclControl->GetWidth() - 1;
00152         usTop2 = pclControl->GetTop() + usY;
00153         usBottom2 = usTop2 + pclControl->GetHeight() - 1;
00154
00155         // If the control has any pixels in the bounding box.
00156         if (
00157                 (
00158                     (
00159                         (usLeft1 >= usLeft2) &&
00160                         (usLeft1 <= usRight2)
00161                     ) ||
00162                     (
00163                         (usRight1 >= usLeft2) &&
00164                         (usRight1 <= usRight2)
00165                     ) ||
00166                     ((usLeft1 <= usLeft2) && (usRight1 >= usRight2))
00167                 ) &&
00168                 (
00169                     (
00170                         (usTop1 >= usTop2) &&
00171                         (usTop1 <= usBottom2)
00172                     ) ||
00173                     (
00174                         (usBottom1 >= usTop2) &&
00175                         (usBottom1 <= usBottom2)
00176                     ) ||
00177                     ((usTop1 <= usTop2) && (usBottom1 >= usBottom2))
00178                 )
00179             )
00180         {
00181             bMatch = true;
00182         }
00183         else if(
00184                 (
00185                     (
00186                         (usLeft2 >= usLeft1) &&
00187                         (usLeft2 <= usRight1)
00188                     ) ||
00189                     (
00190                         (usRight2 >= usLeft1) &&
00191                         (usRight2 <= usRight1)
00192                     ) ||
00193                     ((usLeft2 <= usLeft1) && (usRight2 >= usRight1))
00194                 ) &&
00195                 (
00196                     (
00197                         (usTop2 >= usTop1) &&
00198                         (usTop2 <= usBottom1)
00199                     ) ||
00200                     (
00201                         (usBottom2 >= usTop1) &&
00202                         (usBottom2 <= usBottom1)
00203                     ) ||
00204                     ((usTop2 <= usTop1) && (usBottom2 >= usBottom1))
00205                 )
00206             )
00207         {
00208             bMatch = true;
00209         }
00210
00211
00212         if (bMatch)
00213         {
00214             pclControl->SetStale();
00215
00216             // Invalidate all child controls as well (since redrawing a parent could cause them to
      disappear)
00217             GuiControl *pclChild = static_cast<GuiControl*>(
      m_clControlList.GetHead());
00218
00219             // Go through all controls and check for parental ancestry
00220             while (pclChild)
00221             {
00222                 GuiControl *pclParent = static_cast<GuiControl*>(pclChild->
      GetParentControl());
00223
00224                 // If this control is a descendant of the current control at some level
00225                 while (pclParent)
00226                 {
00227                     if (pclParent == pclControl)
00228                     {
00229                         // Set the control as stale
00230                         pclChild->SetStale();
00231                         break;
00232                     }
```

```
00233                     pclParent = pclParent->GetParentControl();
00234                 }
00235
00236                 pclChild = static_cast<GuiControl*>((static_cast<
    LinkListNode*>(pclChild))->GetNext());
00237             }
00238         }
00239
00240         pclTempNode = pclTempNode->GetNext();
00241     }
00242 }
00243
00244 //---------------------------------------------------------------------------
00245 void GuiWindow::ProcessEvent( GuiEvent_t *pstEvent_ )
00246 {
00247     GUI_DEBUG_PRINT("GuiWindow::ProcessEvent\n");
00248
00249     // If the event is for broadcast - send it to all controls,
00250     // without regard to order.
00251     if ((TARGET_ID_BROADCAST == pstEvent_->ucTargetID)
00252         || (TARGET_ID_BROADCAST_Z == pstEvent_->ucTargetID))
00253     {
00254         GUI_DEBUG_PRINT("  TARGET_ID_BROADCAST(_Z)\n");
00255
00256         LinkListNode *pclTempNode;
00257         pclTempNode = m_clControlList.GetHead();
00258
00259         while (pclTempNode)
00260         {
00261             GuiReturn_t eRet;
00262             eRet = (static_cast<GuiControl*>(pclTempNode))->ProcessEvent(pstEvent_);
00263             if (GUI_EVENT_CONSUMED == eRet)
00264             {
00265                 break;
00266             }
00267             pclTempNode = pclTempNode->GetNext();
00268         }
00269     }
00270     // Send the event only to the currently-selected object.
00271     else if (TARGET_ID_FOCUS == pstEvent_->ucTargetID)
00272     {
00273         GUI_DEBUG_PRINT("  TARGET_ID_FOCUS\n");
00274         GuiReturn_t eReturn = GUI_EVENT_OK;
00275
00276         // Try to let the control process the event on its own
00277         if (m_pclInFocus)
00278         {
00279             eReturn = m_pclInFocus->ProcessEvent(pstEvent_);
00280         }
00281
00282         // If the event was not consumed, use default logic to process the event
00283         if (GUI_EVENT_CONSUMED != eReturn)
00284         {
00285             if (EVENT_TYPE_KEYBOARD == pstEvent_->ucEventType)
00286             {
00287                 if (KEYCODE_TAB == pstEvent_->stKey.ucKeyCode)
00288                 {
00289                     if (pstEvent_->stKey.bKeyState)
00290                     {
00291                         CycleFocus(true);
00292                     }
00293                 }
00294             }
00295             else if (EVENT_TYPE_JOYSTICK == pstEvent_->
    ucEventType)
00296             {
00297                 if (pstEvent_->stJoystick.bUp || pstEvent_->
    stJoystick.bLeft)
00298                 {
00299                     // Cycle focus *backwards*
00300                     CycleFocus(false);
00301                 }
00302                 else if (pstEvent_->stJoystick.bRight || pstEvent_->
    stJoystick.bDown)
00303                 {
00304                     // Cycle focus *forewards*
00305                     CycleFocus(true);
00306                 }
00307             }
00308         }
00309     }
00310     else if (TARGET_ID_HIGH_Z == pstEvent_->ucTargetID)
00311     {
00312         GUI_DEBUG_PRINT("  TARGET_ID_HIGH_Z\n");
00313
00314         K_USHORT usTargetX, usTargetY;
00315         K_USHORT usOffsetX, usOffsetY;
```

```
00316         K_UCHAR ucMaxZ = 0;
00317 
00318         LinkListNode *pclTempNode;
00319         pclTempNode = m_clControlList.GetHead();
00320 
00321         switch (pstEvent_->ucEventType)
00322         {
00323             case EVENT_TYPE_MOUSE:
00324             case EVENT_TYPE_TOUCH:
00325             {
00326                 GuiControl *pclTargetControl = NULL;
00327 
00328                 // Read the target X/Y coordinates out of the event struct
00329                 if (EVENT_TYPE_TOUCH == pstEvent_->ucEventType)
00330                 {
00331                     usTargetX = pstEvent_->stTouch.usX;
00332                     usTargetY = pstEvent_->stTouch.usY;
00333                 }
00334                 else
00335                 {
00336                     usTargetX = pstEvent_->stMouse.usX;
00337                     usTargetY = pstEvent_->stMouse.usY;
00338                 }
00339 
00340                 // Go through every control on the window, checking to see if the
00341                 // event falls within the bounding box
00342                 while (pclTempNode)
00343                 {
00344                     GuiControl *pclControl = (static_cast<GuiControl*>(pclTempNode));
00345 
00346                     pclControl->GetControlOffset(&usOffsetX, &usOffsetY);
00347 
00348                     // Compare event coordinates to bounding box (with offsets)
00349                     if ( ((usTargetX >= (usOffsetX + pclControl->GetLeft()) &&
00350                          (usTargetX <= (usOffsetX + pclControl->GetLeft() + pclControl->
      GetWidth() - 1)))) &&
00351                         ((usTargetY >= (usOffsetY + pclControl->GetTop()) &&
00352                          (usTargetY <= (usOffsetY + pclControl->GetTop() + pclControl->
      GetHeight() - 1)))) )
00353                     {
00354                         // If this control is higher in Z-Order, set this as the newest
00355                         // candidate control to accept the event
00356                         if (pclControl->GetZOrder() >= ucMaxZ)
00357                         {
00358                             pclTargetControl = pclControl;
00359                             ucMaxZ = pclControl->GetZOrder();
00360                         }
00361                     }
00362 
00363                     pclTempNode = pclTempNode->GetNext();
00364                 }
00365 
00366                 // If a suitable control was found on the event surface, pass the event off
00367                 // for processing.
00368                 if (pclTargetControl)
00369                 {
00370                     // If the selected control is different from the current in-focus
00371                     // control, then deactive that control.
00372                     if (m_pclInFocus && (m_pclInFocus != pclTargetControl))
00373                     {
00374                         m_pclInFocus->Activate(false);
00375                         m_pclInFocus = NULL;
00376                     }
00377                     (static_cast<GuiControl*>(pclTargetControl))->ProcessEvent(pstEvent_);
00378                 }
00379             }
00380                 break;
00381             default:
00382                 break;
00383         }
00384     }
00385 }
00386 //---------------------------------------------------------------------------
00387 void GuiWindow::SetFocus( GuiControl *pclControl_ )
00388 {
00389     GUI_DEBUG_PRINT("GuiWindow::SetFocus\n");
00390 
00391     m_pclInFocus = pclControl_;
00392 }
00393 
00394 //---------------------------------------------------------------------------
00395 void GuiWindow::CycleFocus( bool bForward_ )
00396 {
00397     GUI_DEBUG_PRINT("GuiWindow::CycleFocus\n");
00398 
00399     // Set starting point and cached copy of current nodes
00400     LinkListNode *pclTempNode = static_cast<GuiControl*>(
```

```
    m_clControlList.GetHead());
00401     LinkListNode *pclStartNode = m_pclInFocus;
00402 
00403     if (bForward_)
00404     {
00405         // If there isn't a current focus node, set the focus to the beginning
00406         // of the list
00407         if (!m_pclInFocus)
00408         {
00409             m_pclInFocus = static_cast<GuiControl*>(pclTempNode);
00410             if (!m_pclInFocus)
00411             {
00412                 return;
00413             }
00414             pclTempNode = static_cast<GuiControl*>(m_pclInFocus);
00415             pclStartNode = NULL;
00416         }
00417         else
00418         {
00419             // Deactivate the control that's losing focus
00420             static_cast<GuiControl*>(m_pclInFocus)->Activate(false);
00421 
00422             // Otherwise start with the next node
00423             pclStartNode = pclStartNode->GetNext();
00424         }
00425 
00426         // Go through the whole control list and find the next one to accept
00427         // the focus
00428         while (pclTempNode && pclTempNode != pclStartNode)
00429         {
00430             if (static_cast<GuiControl*>(pclTempNode)->AcceptsFocus())
00431             {
00432                 m_pclInFocus = static_cast<GuiControl*>(pclTempNode);
00433                 m_pclInFocus->Activate(true);
00434                 SetFocus(m_pclInFocus);
00435                 return;
00436             }
00437             pclTempNode = pclTempNode->GetNext();
00438         }
00439 
00440         pclTempNode = static_cast<GuiControl*>(m_clControlList.
    GetHead());
00441         while (pclTempNode && pclTempNode != pclStartNode)
00442         {
00443             if (static_cast<GuiControl*>(pclTempNode)->AcceptsFocus())
00444             {
00445                 m_pclInFocus = static_cast<GuiControl*>(pclTempNode);
00446                 m_pclInFocus->Activate(true);
00447                 SetFocus(m_pclInFocus);
00448                 return;
00449             }
00450             pclTempNode = pclTempNode->GetNext();
00451         }
00452     }
00453     else
00454     {
00455         pclTempNode = static_cast<GuiControl*>(m_clControlList.
    GetTail());
00456         pclStartNode = m_pclInFocus;
00457 
00458         // If there isn't a current focus node, set the focus to the end
00459         // of the list
00460         if (!m_pclInFocus)
00461         {
00462             m_pclInFocus = static_cast<GuiControl*>(pclTempNode);
00463             if (!m_pclInFocus)
00464             {
00465                 return;
00466             }
00467             pclTempNode = static_cast<GuiControl*>(m_pclInFocus);
00468             pclStartNode = NULL;
00469         }
00470         else
00471         {
00472             // Deactivate the control that's losing focus
00473             static_cast<GuiControl*>(m_pclInFocus)->Activate(false);
00474 
00475             // Otherwise start with the previous node
00476             pclStartNode = pclStartNode->GetPrev();
00477         }
00478 
00479         // Go through the whole control list and find the next one to accept
00480         // the focus
00481         while (pclTempNode && pclTempNode != pclStartNode)
00482         {
00483             if (static_cast<GuiControl*>(pclTempNode)->AcceptsFocus())
00484             {
```

```
00485                 m_pclInFocus = static_cast<GuiControl*>(pclTempNode);
00486                 m_pclInFocus->Activate(true);
00487                 SetFocus(m_pclInFocus);
00488                 return;
00489             }
00490             pclTempNode = pclTempNode->GetPrev();
00491         }
00492 
00493         pclTempNode = static_cast<GuiControl*>(m_clControlList.
      GetTail());
00494         while (pclTempNode && pclTempNode != pclStartNode)
00495         {
00496             if (static_cast<GuiControl*>(pclTempNode)->AcceptsFocus())
00497             {
00498                 m_pclInFocus = static_cast<GuiControl*>(pclTempNode);
00499                 m_pclInFocus->Activate(true);
00500                 SetFocus(m_pclInFocus);
00501                 return;
00502             }
00503             pclTempNode = pclTempNode->GetPrev();
00504         }
00505     }
00506 }
00507 //---------------------------------------------------------------------------
00508 GuiWindow *GuiEventSurface::FindWindowByName( const K_CHAR *
      szName_ )
00509 {
00510     LinkListNode *pclTempNode = static_cast<LinkListNode*>(
      m_clWindowList.GetHead());
00511 
00512     while (pclTempNode)
00513     {
00514         if (MemUtil::CompareStrings(szName_, static_cast<GuiWindow*>(pclTempNode)->
      GetName()))
00515         {
00516              return static_cast<GuiWindow*>(pclTempNode);
00517         }
00518         pclTempNode = pclTempNode->GetNext();
00519     }
00520 
00521     return NULL;
00522 }
00523 
00524 //---------------------------------------------------------------------------
00525 void GuiEventSurface::AddWindow( GuiWindow *pclWindow_ )
00526 {
00527     GUI_DEBUG_PRINT("GuiEventSurface::AddWindow\n");
00528 
00529     m_clWindowList.Add(static_cast<LinkListNode*>(pclWindow_));
00530 }
00531 
00532 //---------------------------------------------------------------------------
00533 void GuiEventSurface::RemoveWindow( GuiWindow *pclWindow_ )
00534 {
00535     GUI_DEBUG_PRINT("GuiEventSurface::RemoveWindow\n");
00536 
00537     m_clWindowList.Remove(static_cast<LinkListNode*>(pclWindow_));
00538 }
00539 
00540 //---------------------------------------------------------------------------
00541 K_BOOL GuiEventSurface::SendEvent( GuiEvent_t *pstEvent_ )
00542 {
00543     GUI_DEBUG_PRINT("GuiEventSurface::SendEvent\n");
00544 
00545     // Allocate a message from the global message pool
00546     Message *pclMessage = GlobalMessagePool::Pop();
00547 
00548     // No messages available? Return a failure
00549     if (!pclMessage)
00550     {
00551         return false;
00552     }
00553 
00554     // Allocate a copy of the event from the heap
00555     GuiEvent_t *pstEventCopy = static_cast<GuiEvent_t*>(
      SystemHeap::Alloc(sizeof(GuiEvent_t)));
00556 
00557     // If the allocation fails, push the message back to the global pool and bail
00558     if (!pstEventCopy)
00559     {
00560         GlobalMessagePool::Push(pclMessage);
00561         return false;
00562     }
00563 
00564     // Copy the source event into the destination event buffer
00565     CopyEvent(pstEventCopy, pstEvent_);
00566 
```

```
00567     // Set the new event as the message payload
00568     pclMessage->SetData(static_cast<void*>(pstEventCopy));
00569 
00570     // Send the event to the message queue
00571     m_clMessageQueue.Send(pclMessage);
00572 
00573     return true;
00574 }
00575 
00576 //---------------------------------------------------------------------------
00577 K_BOOL GuiEventSurface::ProcessEvent()
00578 {
00579     GUI_DEBUG_PRINT("GuiEventSurface::ProcessEvent\n");
00580 
00581     // read the event from the queue (blocking call)
00582     Message *pclMessage = m_clMessageQueue.Receive();
00583     GuiEvent_t stLocalEvent;
00584 
00585     // If we failed to get something from the queue,
00586     // bail out
00587     if (!pclMessage)
00588     {
00589         return false;
00590     }
00591 
00592     // Copy the event data from the message into a local copy
00593     CopyEvent(&stLocalEvent,
00594         static_cast<GuiEvent_t*>(pclMessage->GetData()));
00595 
00596     // Free the message and event as soon as possible, since
00597     // they are shared system resources
00598     SystemHeap::Free(pclMessage->GetData());
00599     GlobalMessagePool::Push(pclMessage);
00600 
00601     // Special case check - target ID is the highest Z-ordered window(s) ONLY.
00602     if (stLocalEvent.ucTargetID == TARGET_ID_BROADCAST_Z)
00603     {
00604         LinkListNode* pclTempNode = m_clWindowList.
      GetHead();
00605         K_UCHAR ucMaxZ = 0;
00606 
00607         while (pclTempNode)
00608         {
00609             if (ucMaxZ < (static_cast<GuiWindow*>(pclTempNode))->GetZOrder() )
00610             {
00611                 ucMaxZ = static_cast<GuiWindow*>(pclTempNode)->GetZOrder();
00612             }
00613             pclTempNode = pclTempNode->GetNext();
00614         }
00615 
00616         // Iterate through all windows again - may have multiple windows
00617         // at the same z-order.
00618         pclTempNode = m_clWindowList.GetHead();
00619         while (pclTempNode)
00620         {
00621             if (ucMaxZ == (static_cast<GuiWindow*>(pclTempNode))->GetZOrder())
00622             {
00623                 (static_cast<GuiWindow*>(pclTempNode))->ProcessEvent(&stLocalEvent);
00624             }
00625             pclTempNode = pclTempNode->GetNext();
00626         }
00627     }
00628     // Broadcast the event - sending it to *all* windows.  Let the individual
00629     // windows figure out what to do with the events.
00630     else
00631     {
00632         LinkListNode* pclTempNode = m_clWindowList.
      GetHead();
00633         while (pclTempNode)
00634         {
00635             (static_cast<GuiWindow*>(pclTempNode))->ProcessEvent(&stLocalEvent);
00636             pclTempNode = pclTempNode->GetNext();
00637         }
00638     }
00639 
00640     // Return out
00641     return true;
00642 }
00643 
00644 //---------------------------------------------------------------------------
00645 void GuiEventSurface::CopyEvent( GuiEvent_t *pstDst_,
      GuiEvent_t *pstSrc_ )
00646 {
00647     GUI_DEBUG_PRINT("GuiEventSurface::CopyEvent\n");
00648     K_UCHAR *pucDst_ = (K_UCHAR*)pstDst_;
00649     K_UCHAR *pucSrc_ = (K_UCHAR*)pstSrc_;
00650     K_UCHAR i;
```

```
00651     for (i = 0; i < sizeof(GuiEvent_t); i++)
00652     {
00653         *pucDst_++ = *pucSrc_++;
00654     }
00655 }
00656
00657 //---------------------------------------------------------------------------
00658 void GuiEventSurface::InvalidateRegion( K_USHORT usLeft_, K_USHORT usTop_,
       K_USHORT usWidth_, K_USHORT usHeight_ )
00659 {
00660     LinkListNode* pclTempNode = m_clWindowList.GetHead();
00661     while (pclTempNode)
00662     {
00663         (static_cast<GuiWindow*>(pclTempNode))->InvalidateRegion(usLeft_, usTop_, usWidth_,
      usWidth_);
00664         pclTempNode = pclTempNode->GetNext();
00665     }
00666 }
00667
00668 //---------------------------------------------------------------------------
00669 void GuiControl::GetControlOffset( K_USHORT *pusX_, K_USHORT *pusY_ )
00670 {
00671     GUI_DEBUG_PRINT("GuiControl::GetControlOffset\n");
00672     GuiControl *pclTempControl = m_pclParentControl;
00673     *pusX_ = 0;
00674     *pusY_ = 0;
00675     while (pclTempControl)
00676     {
00677         *pusX_ += pclTempControl->GetLeft();
00678         *pusY_ += pclTempControl->GetTop();
00679         pclTempControl = pclTempControl->GetParentControl();
00680     }
00681
00682     if (m_pclParentWindow)
00683     {
00684         *pusX_ += m_pclParentWindow->GetLeft();
00685         *pusY_ += m_pclParentWindow->GetTop();
00686     }
00687 }
```

14.65 /home/moslevin2/mark3/embedded/stage/src/gui.h File Reference

Graphical User Interface classes and data structure declarations.

```
#include "kerneltypes.h"
#include "ll.h"
#include "driver.h"
#include "graphics.h"
#include "message.h"
#include "keycodes.h"
```

Classes

- struct KeyEvent_t

  Keyboard UI event structure definition.
- struct MouseEvent_t

  Mouse UI event structure.
- struct TouchEvent_t

  Touch UI event structure.
- struct JoystickEvent_t

  Joystick UI event structure.
- struct TimerEvent_t

  Timer UI event structure.
- struct GuiEvent_t

  Composite UI event structure.
- class GuiWindow

Basic Window Class.

- class GuiEventSurface

  GUI Event Surface Object.

- class GuiControl

  GUI Control Base Class.

- class StubControl

  Stub control class, used for testing out the GUI framework where certain controls have not yet been implemented.

Macros

- #define **GUI_DEBUG** (0)
- #define **GUI_DEBUG_PRINT**(...)
- #define EVENT_STATE_UP (0)

  Event state defintions, used for determining whether or not a button or key is in the "up" or "down" contact state.

- #define **EVENT_STATE_DOWN** (1)
- #define MAX_WINDOW_CONTROLS (251)

  Maximum number of controls per window.

- #define TARGET_ID_BROADCAST_Z (252)

  Broadcast event to all controls in the topmost window.

- #define TARGET_ID_BROADCAST (253)

  Send event to all controls in all windows.

- #define TARGET_ID_FOCUS (254)

  Send event to the in-focus control.

- #define TARGET_ID_HIGH_Z (255)

  Send event to the highest Z-order control.

Enumerations

- enum GuiEventType_t {
  EVENT_TYPE_KEYBOARD, EVENT_TYPE_MOUSE, EVENT_TYPE_TOUCH, EVENT_TYPE_JOYSTICK,
  EVENT_TYPE_TIMER, EVENT_TYPE_COUNT }

  Enumeration defining the various UI event codes.

- enum GuiReturn_t {
  GUI_EVENT_OK = 0, GUI_EVENT_CONSUMED, GUI_EVENT_CANCEL, GUI_EVENT_RETRY,
  GUI_EVENT_COUNT }

14.65.1 Detailed Description

Graphical User Interface classes and data structure declarations.

Definition in file gui.h.

14.65.2 Enumeration Type Documentation

14.65.2.1 enum GuiEventType_t

Enumeration defining the various UI event codes.

Enumerator

EVENT_TYPE_KEYBOARD Keypress event.

EVENT_TYPE_MOUSE Mouse movement or click event.

EVENT_TYPE_TOUCH Touchscreen movement event.

EVENT_TYPE_JOYSTICK Joystick event.

EVENT_TYPE_TIMER Timer event.

EVENT_TYPE_COUNT Count of different event types supported.

Definition at line 65 of file gui.h.

14.65.2.2 enum GuiReturn_t

Enumerator

GUI_EVENT_OK No problem.

GUI_EVENT_CONSUMED Event was consumed.

GUI_EVENT_CANCEL Event processing canceled.

GUI_EVENT_RETRY Retry processing the event.

Definition at line 203 of file gui.h.

14.66 gui.h

```
00001 /*=========================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__   ___|_    |__   ___|__    |__   ___| __   |__   ______
00004 |    \   /   | ||    \       ||       |      ||   |/ /      ||___    |
00005 |     \/    | ||     \      ||       \      ||      \      ||___    |
00006 |__/\__/|__|_||__|\__\   ___||__|\__\   ___||__|\__\   ___||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00019 #ifndef __GUI_H__
00020 #define __GUI_H__
00021
00022 #include "kerneltypes.h"
00023 #include "ll.h"
00024 #include "driver.h"
00025 #include "graphics.h"
00026
00027 #include "message.h"
00028
00029 #include "keycodes.h"
00030
00031 #define GUI_DEBUG           (0)
00032
00033 #if GUI_DEBUG
00034     #include <stdio.h>
00035     #include <stdlib.h>
00036     #include <string.h>
00037
00038     #define GUI_DEBUG_PRINT     printf
00039 #else
00040 #define GUI_DEBUG_PRINT(...)
00041 #endif
00042
00043
00044 //---------------------------------------------------------------------------
00049 #define EVENT_STATE_UP          (0)
00050 #define EVENT_STATE_DOWN        (1)
00051
00052 //---------------------------------------------------------------------------
00053 #define MAX_WINDOW_CONTROLS     (251)
00054
00055 #define TARGET_ID_BROADCAST_Z   (252)
00056 #define TARGET_ID_BROADCAST     (253)
00057 #define TARGET_ID_FOCUS         (254)
00058 #define TARGET_ID_HIGH_Z        (255)
00059
00060
00061 //---------------------------------------------------------------------------
```

```
00065 typedef enum
00066 {
00067     EVENT_TYPE_KEYBOARD,
00068     EVENT_TYPE_MOUSE,
00069     EVENT_TYPE_TOUCH,
00070     EVENT_TYPE_JOYSTICK,
00071     EVENT_TYPE_TIMER,
00072 //---
00073     EVENT_TYPE_COUNT
00074 } GuiEventType_t;
00075
00076 //-----------------------------------------------------------------------
00080 typedef struct
00081 {
00082     K_UCHAR ucKeyCode;
00083     union
00084     {
00085         K_UCHAR ucFlags;
00086         struct
00087         {
00088             unsigned int bKeyState:1;
00089             unsigned int bShiftState:1;
00090             unsigned int bCtrlState:1;
00091             unsigned int bAltState:1;
00092             unsigned int bWinState:1;
00093             unsigned int bFnState:1;
00094         };
00095     };
00096 } KeyEvent_t;
00097
00098 //-----------------------------------------------------------------------
00102 typedef struct
00103 {
00104     K_USHORT usX;
00105     K_USHORT usY;
00106
00107     union
00108     {
00109         K_UCHAR ucFlags;
00110         struct
00111         {
00112             unsigned int bLeftState:1;
00113             unsigned int bRightState:1;
00114             unsigned int bMiddleState:1;
00115             unsigned int bScrollUp:1;
00116             unsigned int bScrollDown:1;
00117         };
00118     };
00119 } MouseEvent_t;
00120
00121 //-----------------------------------------------------------------------
00125 typedef struct
00126 {
00127     K_USHORT usX;
00128     K_USHORT usY;
00129
00130     union
00131     {
00132         K_USHORT ucFlags;
00133         struct
00134         {
00135             unsigned int bTouch:1;
00136         };
00137     };
00138 } TouchEvent_t;
00139
00140 //-----------------------------------------------------------------------
00144 typedef struct
00145 {
00146     union
00147     {
00148         K_USHORT usRawData;
00149         struct
00150         {
00151             unsigned int bUp:1;
00152             unsigned int bDown:1;
00153             unsigned int bLeft:1;
00154             unsigned int bRight:1;
00155
00156             unsigned int bButton1:1;
00157             unsigned int bButton2:1;
00158             unsigned int bButton3:1;
00159             unsigned int bButton4:1;
00160             unsigned int bButton5:1;
00161             unsigned int bButton6:1;
00162             unsigned int bButton7:1;
00163             unsigned int bButton8:1;
```

```
00164             unsigned int bButton9:1;
00165             unsigned int bButton10:1;
00166 
00167             unsigned int bSelect:1;
00168             unsigned int bStart:1;
00169         };
00170     };
00171 } JoystickEvent_t;
00172 
00173 //---------------------------------------------------------------------------
00177 typedef struct
00178 {
00179     K_USHORT usTicks;
00180 } TimerEvent_t;
00181 
00182 //---------------------------------------------------------------------------
00187 typedef struct
00188 {
00189     K_UCHAR ucEventType;
00190     K_UCHAR ucTargetID;
00191     union
00192     {
00193         KeyEvent_t        stKey;
00194         MouseEvent_t    stMouse;
00195         TouchEvent_t    stTouch;
00196         JoystickEvent_t stJoystick;
00197         TimerEvent_t    stTimer;
00198     };
00199 
00200 } GuiEvent_t;
00201 
00202 //---------------------------------------------------------------------------
00203 typedef enum
00204 {
00205     GUI_EVENT_OK = 0,
00206     GUI_EVENT_CONSUMED,
00207     GUI_EVENT_CANCEL,
00208     GUI_EVENT_RETRY,
00209 //---
00210     GUI_EVENT_COUNT
00211 } GuiReturn_t;
00212 
00213 class GuiControl;
00214 
00215 //---------------------------------------------------------------------------
00223 class GuiWindow : public LinkListNode
00224 {
00225 
00226 public:
00231     void Init()
00232     {
00233         m_ucControlCount = 0;
00234         m_pclDriver = NULL;
00235         m_szName = "";
00236     }
00237 
00244     void SetDriver( GraphicsDriver *pclDriver_ ) {
      m_pclDriver = pclDriver_; }
00245 
00252     GraphicsDriver *GetDriver() { return m_pclDriver; }
00253 
00265     void AddControl( GuiControl *pclControl_, GuiControl *pclParent_ );
00266 
00274     void RemoveControl( GuiControl *pclControl_ );
00275 
00283     K_UCHAR GetMaxZOrder();
00284 
00293     void Redraw( K_BOOL bRedrawAll_ );
00294 
00301     void ProcessEvent( GuiEvent_t *pstEvent_ );
00302 
00311     void SetFocus( GuiControl *pclControl_ );
00312 
00323     K_BOOL IsInFocus( GuiControl *pclControl_ )
00324     {
00325         if (m_pclInFocus == pclControl_)
00326         {
00327             return true;
00328         }
00329         return false;
00330     }
00331 
00337     void SetTop( K_USHORT usTop_ )          { m_usTop = usTop_; }
00338 
00344     void SetLeft( K_USHORT usLeft_ )       { m_usLeft = usLeft_; }
00345 
00351     void SetHeight( K_USHORT usHeight_ ) { m_usHeight = usHeight_; }
```

```
00352
00358     void SetWidth( K_USHORT usWidth_ )    { m_usWidth = usWidth_; }
00359
00365     K_USHORT GetTop()              { return m_usTop; }
00366
00372     K_USHORT GetLeft()            { return m_usLeft; }
00373
00379     K_USHORT GetHeight()        { return m_usHeight; }
00380
00386     K_USHORT GetWidth()          { return m_usWidth; }
00387
00391     K_UCHAR GetZOrder()          { return m_ucZ; }
00392
00396     void SetZOrder( K_UCHAR ucZ_ ) { m_ucZ = ucZ_; }
00397
00405     void CycleFocus( bool bForward_ );
00406
00410     void SetName( const K_CHAR *szName_ ) { m_szName = szName_; }
00411
00415     const K_CHAR *GetName() { return m_szName; }
00416
00422     void InvalidateRegion( K_USHORT usLeft_, K_USHORT usTop_, K_USHORT usWidth_, K_USHORT
      usHeight_ );
00423
00424 private:
00425     K_USHORT m_usTop;
00426     K_USHORT m_usLeft;
00427     K_USHORT m_usHeight;
00428     K_USHORT m_usWidth;
00429
00430     K_UCHAR  m_ucZ;
00431     const K_CHAR  *m_szName;
00432
00433     DoubleLinkList m_clControlList;
00434     GuiControl *m_pclInFocus;
00435     K_UCHAR m_ucControlCount;
00436     GraphicsDriver *m_pclDriver;
00437 };
00438
00439 //---------------------------------------------------------------------------
00452 class GuiEventSurface
00453 {
00454 public:
00459     void Init() { m_clMessageQueue.Init(); }
00460
00466     void AddWindow( GuiWindow *pclWindow_ );
00467
00473     void RemoveWindow( GuiWindow *pclWindow_ );
00474
00482     K_BOOL SendEvent( GuiEvent_t *pstEvent_ );
00483
00488     K_BOOL ProcessEvent();
00489
00493     K_UCHAR GetEventCount() { return m_clMessageQueue.
      GetCount(); }
00494
00498     GuiWindow *FindWindowByName( const K_CHAR *szName_ );
00499
00505     void InvalidateRegion( K_USHORT usLeft_, K_USHORT usTop_, K_USHORT usWidth_, K_USHORT
      usHeight_ );
00506
00507 private:
00514     void CopyEvent( GuiEvent_t *pstDst_, GuiEvent_t *pstSrc_ );
00515
00516 private:
00520     DoubleLinkList m_clWindowList;
00521
00525     MessageQueue   m_clMessageQueue;
00526 };
00527
00528 //---------------------------------------------------------------------------
00538 class GuiControl : public LinkListNode
00539 {
00540 public:
00547     virtual void Init() = 0;
00548
00554     virtual void Draw() = 0;
00555
00563     virtual GuiReturn_t ProcessEvent( GuiEvent_t *pstEvent_ ) = 0;
00564
00570     void SetTop( K_USHORT usTop_ )          { m_usTop = usTop_; }
00571
00577     void SetLeft( K_USHORT usLeft_ )       { m_usLeft = usLeft_; }
00578
00584     void SetHeight( K_USHORT usHeight_ ) { m_usHeight = usHeight_; }
00585
00591     void SetWidth( K_USHORT usWidth_ )    { m_usWidth = usWidth_; }
```

```
00592
00598     void SetZOrder( K_UCHAR ucZ_ )          { m_ucZOrder = ucZ_; }
00599
00606     void SetControlIndex( K_UCHAR ucIdx_ ) { m_ucControlIndex = ucIdx_; }
00607
00613     K_USHORT GetTop()             { return m_usTop; }
00614
00620     K_USHORT GetLeft()           { return m_usLeft; }
00621
00627     K_USHORT GetHeight()       { return m_usHeight; }
00628
00634     K_USHORT GetWidth()         { return m_usWidth; }
00635
00641     K_UCHAR  GetZOrder()       { return m_ucZOrder; }
00642
00648     K_UCHAR  GetControlIndex()   { return m_ucControlIndex; }
00649
00655     K_BOOL   IsStale()           { return m_bStale; }
00656
00668     void GetControlOffset( K_USHORT *pusX_, K_USHORT *pusY_ );
00669
00677     K_BOOL  IsInFocus()
00678     {
00679         return m_pclParentWindow->IsInFocus(this);
00680     }
00681
00689     virtual void Activate( bool bActivate_ ) = 0;
00690
00691 protected:
00692     friend class GuiWindow;
00693     friend class GuiEventSurface;
00694
00706     void SetParentControl( GuiControl *pclParent_ ) {
    m_pclParentControl = pclParent_; }
00707
00717     void SetParentWindow( GuiWindow *pclWindow_ )   {
    m_pclParentWindow  = pclWindow_; }
00718
00725     GuiControl *GetParentControl()                    { return
    m_pclParentControl; }
00726
00733     GuiWindow *GetParentWindow()                    { return
    m_pclParentWindow; }
00734
00741     void ClearStale()                                 { m_bStale = false; }
00742
00746     void SetStale()                                 { m_bStale = true; }
00747
00751     void SetAcceptFocus( bool bFocus_ )             {
    m_bAcceptsFocus = bFocus_; }
00752
00756     bool AcceptsFocus()                             { return
    m_bAcceptsFocus; }
00757 private:
00759     K_BOOL   m_bStale;
00760
00762     K_BOOL   m_bAcceptsFocus;
00763
00766     K_UCHAR  m_ucZOrder;
00767
00770     K_UCHAR  m_ucControlIndex;
00771
00773     K_USHORT m_usTop;
00774
00776     K_USHORT m_usLeft;
00777
00779     K_USHORT m_usWidth;
00780
00782     K_USHORT m_usHeight;
00783
00785     GuiControl *m_pclParentControl;
00786
00788     GuiWindow  *m_pclParentWindow;
00789 };
00790
00791 //---------------------------------------------------------------------------
00796 class StubControl : public GuiControl
00797 {
00798 public:
00799     virtual void Init() {  }
00800     virtual void Draw() {  }
00801     virtual GuiReturn_t ProcessEvent( GuiEvent_t *pstEvent_ ) { return
    GUI_EVENT_OK; }
00802     virtual void Activate( bool bActivate_ ) { }
00803 };
00804
00805 #endif
```

```
00806
```

14.67 /home/moslevin2/mark3/embedded/stage/src/kernel.cpp File Reference

Kernel initialization and startup code.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "kernel.h"
#include "scheduler.h"
#include "thread.h"
#include "threadport.h"
#include "timerlist.h"
#include "message.h"
#include "driver.h"
#include "profile.h"
#include "kprofile.h"
#include "tracebuffer.h"
#include "kernel_debug.h"
```

Macros

- #define **__FILE_ID__** KERNEL_CPP

14.67.1 Detailed Description

Kernel initialization and startup code.

Definition in file kernel.cpp.

14.68 kernel.cpp

```
00001 /*===========================================================================
00002      _____          _____          _____          _____
00003  ___|    _|__   __|_    |__   __|__    |__   __| __   |__   ______
00004 |    \  /  | ||    \       ||      |     ||  |/ /     ||___    |
00005 |     \/   | ||     \      ||      \     ||     \     ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00021 #include "kerneltypes.h"
00022 #include "mark3cfg.h"
00023
00024 #include "kernel.h"
00025 #include "scheduler.h"
00026 #include "thread.h"
00027 #include "threadport.h"
00028 #include "timerlist.h"
00029 #include "message.h"
00030 #include "driver.h"
00031 #include "profile.h"
00032 #include "kprofile.h"
00033 #include "tracebuffer.h"
00034 #include "kernel_debug.h"
00035
00036 bool Kernel::m_bIsStarted;
00037
00038 //---------------------------------------------------------------------------
00039 #if defined __FILE_ID__
```

```
00040     #undef __FILE_ID__
00041 #endif
00042 #define __FILE_ID__     KERNEL_CPP
00043
00044 //---------------------------------------------------------------------------
00045 void Kernel::Init(void)
00046 {
00047     m_bIsStarted = false;
00048 #if KERNEL_USE_DEBUG
00049     TraceBuffer::Init();
00050 #endif
00051     KERNEL_TRACE( STR_MARK3_INIT );
00052
00053     // Initialize the global kernel data - scheduler, timer-scheduler, and
00054     // the global message pool.
00055     Scheduler::Init();
00056 #if KERNEL_USE_DRIVER
00057     DriverList::Init();
00058 #endif
00059 #if KERNEL_USE_TIMERS
00060     TimerScheduler::Init();
00061 #endif
00062 #if KERNEL_USE_MESSAGE
00063     GlobalMessagePool::Init();
00064 #endif
00065 #if KERNEL_USE_PROFILER
00066     Profiler::Init();
00067 #endif
00068 }
00069
00070 //---------------------------------------------------------------------------
00071 void Kernel::Start(void)
00072 {
00073     KERNEL_TRACE( STR_THREAD_START );
00074     m_bIsStarted = true;
00075     ThreadPort::StartThreads();
00076     KERNEL_TRACE( STR_START_ERROR );
00077
00078 }
```

14.69 /home/moslevin2/mark3/embedded/stage/src/kernel.h File Reference

Kernel initialization and startup class.

```
#include "kerneltypes.h"
```

Classes

- class Kernel

  Class that encapsulates all of the kernel startup functions.

14.69.1 Detailed Description

Kernel initialization and startup class. The Kernel namespace provides functions related to initializing and starting up the kernel.

The Kernel::Init() function must be called before any of the other functions in the kernel can be used.

Once the initial kernel configuration has been completed (i.e. first threads have been added to the scheduler), the Kernel::Start() function can then be called, which will transition code execution from the "main()" context to the threads in the scheduler.

Definition in file kernel.h.

14.70 kernel.h

```
00001 /*===========================================================================
```

```
00002      _____          _____          _____          _____
00003  ___|     _|__   ___|_    |__   ___|__    |__   ___| __   |__   ______
00004 |     \   /   | ||     \       ||       |      ||   |/ /      ||___    |
00005 |      \/     | ||      \      ||       \      ||      \      ||___    |
00006 |__/\__/|__|_||__|\__\   __||__|\__\   __||__|\__\   __||______|
00007      |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]-----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00032 #ifndef __KERNEL_H__
00033 #define __KERNEL_H__
00034
00035 #include "kerneltypes.h"
00036 //---------------------------------------------------------------------------
00040 class Kernel
00041 {
00042 public:
00051     static void Init(void);
00052
00065     static void Start(void);
00066
00072     static bool IsStarted()    {   return m_bIsStarted;    }
00073
00074 private:
00075
00076     static bool m_bIsStarted;
00077 };
00078
00079 #endif
00080
```

14.71 /home/moslevin2/mark3/embedded/stage/src/kernel_debug.h File Reference

Macros and functions used for assertions, kernel traces, etc.

```
#include "debug_tokens.h"
#include "mark3cfg.h"
#include "tracebuffer.h"
```

Macros

- #define **__FILE_ID__** 0
- #define **KERNEL_TRACE**(x)
- #define **KERNEL_TRACE_1**(x, arg1)
- #define **KERNEL_TRACE_2**(x, arg1, arg2)
- #define **KERNEL_ASSERT**(x)

14.71.1 Detailed Description

Macros and functions used for assertions, kernel traces, etc.

Definition in file kernel_debug.h.

14.72 kernel_debug.h

```
00001 /*===========================================================================
00002      _____          _____          _____          _____
00003  ___|     _|__   ___|_    |__   ___|__    |__   ___| __   |__   ______
00004 |     \   /   | ||     \       ||       |      ||   |/ /      ||___    |
00005 |      \/     | ||      \      ||       \      ||      \      ||___    |
00006 |__/\__/|__|_||__|\__\   __||__|\__\   __||__|\__\   __||______|
00007      |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]-----------------------------------------------
```

```
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00020 #ifndef __KERNEL_DEBUG_H__
00021 #define __KERNEL_DEBUG_H__
00022
00023 #include "debug_tokens.h"
00024 #include "mark3cfg.h"
00025 #include "tracebuffer.h"
00026
00027 //---------------------------------------------------------------------------
00028 #if KERNEL_USE_DEBUG
00029
00030 //---------------------------------------------------------------------------
00031 #define __FILE_ID__         STR_UNDEFINED
00032
00033 //---------------------------------------------------------------------------
00034 #define KERNEL_TRACE( x )   \
00035 {   \
00036     K_USHORT ausMsg__[5]; \
00037     ausMsg__[0] = 0xACDC;  \
00038     ausMsg__[1] = __FILE_ID__; \
00039     ausMsg__[2] = __LINE__; \
00040     ausMsg__[3] = TraceBuffer::Increment() ; \
00041     ausMsg__[4] = (K_USHORT)(x) ; \
00042     TraceBuffer::Write(ausMsg__, 5); \
00043 };
00044
00045 //---------------------------------------------------------------------------
00046 #define KERNEL_TRACE_1( x, arg1 ) \
00047 {   \
00048     K_USHORT ausMsg__[6]; \
00049     ausMsg__[0] = 0xACDC;  \
00050     ausMsg__[1] = __FILE_ID__; \
00051     ausMsg__[2] = __LINE__; \
00052     ausMsg__[3] = TraceBuffer::Increment(); \
00053     ausMsg__[4] = (K_USHORT)(x); \
00054     ausMsg__[5] = arg1; \
00055     TraceBuffer::Write(ausMsg__, 6); \
00056 }
00057
00058 //---------------------------------------------------------------------------
00059 #define KERNEL_TRACE_2( x, arg1, arg2 ) \
00060 {   \
00061     K_USHORT ausMsg__[7]; \
00062     ausMsg__[0] = 0xACDC;  \
00063     ausMsg__[1] = __FILE_ID__; \
00064     ausMsg__[2] = __LINE__; \
00065     ausMsg__[3] = TraceBuffer::Increment(); \
00066     ausMsg__[4] = (K_USHORT)(x); \
00067     ausMsg__[5] = arg1; \
00068     ausMsg__[6] = arg2; \
00069     TraceBuffer::Write(ausMsg__, 7); \
00070 }
00071
00072 //---------------------------------------------------------------------------
00073 #define KERNEL_ASSERT( x ) \
00074 {       \
00075     if( ( x ) == false ) \
00076     {   \
00077         K_USHORT ausMsg__[5];   \
00078         ausMsg__[0] = 0xACDC;   \
00079         ausMsg__[1] = __FILE_ID__;  \
00080         ausMsg__[2] = __LINE__; \
00081         ausMsg__[3] = TraceBuffer::Increment(); \
00082         ausMsg__[4] = STR_ASSERT_FAILED;    \
00083         TraceBuffer::Write(ausMsg__, 5); \
00084     }   \
00085 }
00086
00087 #else
00088 //---------------------------------------------------------------------------
00089 #define __FILE_ID__         0
00090 //---------------------------------------------------------------------------
00091 #define KERNEL_TRACE( x )
00092 //---------------------------------------------------------------------------
00093 #define KERNEL_TRACE_1( x, arg1 )
00094 //---------------------------------------------------------------------------
00095 #define KERNEL_TRACE_2( x, arg1, arg2 )
00096 //---------------------------------------------------------------------------
00097 #define KERNEL_ASSERT( x )
00098
00099 #endif // KERNEL_USE_DEBUG
00100
00101 #endif
```

14.73 /home/moslevin2/mark3/embedded/stage/src/kernelswi.cpp File Reference

Kernel Software interrupt implementation for ATMega328p.

```
#include "kerneltypes.h"
#include "kernelswi.h"
#include <avr/io.h>
#include <avr/interrupt.h>
```

14.73.1 Detailed Description

Kernel Software interrupt implementation for ATMega328p.

Definition in file kernelswi.cpp.

14.74 kernelswi.cpp

```
00001 /*===========================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__   ___|_    |__   ___|__   |__   ___| __   |__   ______
00004 |    \   /   | ||     \       ||      |      ||   |/ /      ||___    |
00005 |     \/    | ||      \      ||      \      ||      \      ||___    |
00006 |__/\__/|__|_||__|\__\   __||__|\__\   __||__|\__\   __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00022 #include "kerneltypes.h"
00023 #include "kernelswi.h"
00024
00025 #include <avr/io.h>
00026 #include <avr/interrupt.h>
00027
00028 //---------------------------------------------------------------------------
00029 void KernelSWI::Config(void)
00030 {
00031     PORTD &= ~0x04; // Clear INT0
00032     DDRD |= 0x04;    // Set PortD, bit 2 (INT0) As Output
00033     EICRA |= (1 << ISC00) | (1 << ISC01);    // Rising edge on INT0
00034 }
00035
00036 //---------------------------------------------------------------------------
00037 void KernelSWI::Start(void)
00038 {
00039     EIFR &= ~(1 << INTF0);    // Clear any pending interrupts on INT0
00040     EIMSK |= (1 << INT0);    // Enable INT0 interrupt (as K_LONG as I-bit is set)
00041 }
00042
00043 //---------------------------------------------------------------------------
00044 void KernelSWI::Stop(void)
00045 {
00046     EIMSK &= ~(1 << INT0);    // Disable INT0 interrupts
00047 }
00048
00049 //---------------------------------------------------------------------------
00050 K_UCHAR KernelSWI::DI()
00051 {
00052     K_UCHAR bEnabled = ((EIMSK & (1 << INT0)) != 0);
00053     EIMSK &= ~(1 << INT0);
00054     return bEnabled;
00055 }
00056
00057 //---------------------------------------------------------------------------
00058 void KernelSWI::RI(K_UCHAR bEnable_)
00059 {
00060     if (bEnable_)
00061     {
00062         EIMSK |= (1 << INT0);
00063     }
00064     else
00065     {
00066         EIMSK &= ~(1 << INT0);
```

```
00067     }
00068 }
00069
00070 //---------------------------------------------------------------------------
00071 void KernelSWI::Clear(void)
00072 {
00073     EIFR &= ~(1 << INTF0);      // Clear the interrupt flag for INT0
00074 }
00075
00076 //---------------------------------------------------------------------------
00077 void KernelSWI::Trigger(void)
00078 {
00079     //if(Thread_IsSchedulerEnabled())
00080     {
00081         PORTD &= ~0x04;
00082         PORTD |= 0x04;
00083     }
00084 }
```

14.75 /home/moslevin2/mark3/embedded/stage/src/kernelswi.h File Reference

Kernel Software interrupt declarations.

```
#include "kerneltypes.h"
```

Classes

- class KernelSWI

  Class providing the software-interrupt required for context-switching in the kernel.

14.75.1 Detailed Description

Kernel Software interrupt declarations.

Definition in file kernelswi.h.

14.76 kernelswi.h

```
00001 /*===========================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__   ___|_    |__   ___|__   |__   ___| __   |__   ______
00004 |    \  /   | ||     \       ||      |      ||   |/ /      ||___    |
00005 |     \/    | ||      \      ||      \      ||      \      ||___    |
00006 |__/\__/|__|_||__|\__\   __||__|\__\   __||__|\__\   __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]-------------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00023 #include "kerneltypes.h"
00024 #ifndef __KERNELSWI_H_
00025 #define __KERNELSWI_H_
00026
00027 //---------------------------------------------------------------------------
00032 class KernelSWI
00033 {
00034 public:
00041     static void Config(void);
00042
00048     static void Start(void);
00049
00055     static void Stop(void);
00056
00062     static void Clear(void);
00063
00069     static void Trigger(void);
00070
```

```
    static K_UCHAR DI();

    static void RI(K_UCHAR bEnable_);
};


#endif // __KERNELSIW_H_
```

14.77 /home/moslevin2/mark3/embedded/stage/src/kerneltimer.cpp File Reference

Kernel Timer Implementation for ATMega328p.

```
#include "kerneltypes.h"
#include "kerneltimer.h"
#include <avr/io.h>
#include <avr/interrupt.h>
```

Macros

- #define **TCCR1B_INIT** ((1 << WGM12) | (1 << CS12))
- #define **TIMER_IMSK** (1 << OCIE1A)
- #define **TIMER_IFR** (1 << OCF1A)

14.77.1 Detailed Description

Kernel Timer Implementation for ATMega328p.

Definition in file kerneltimer.cpp.

14.78 kerneltimer.cpp

```
/*===========================================================================
     _____     _____     _____     _____
 ___|    _|__ __|_    |__ __|__   |__ __| __  |__ _____
|    \  /  | ||    \      ||     |      ||  |/ /     ||___   |
|     \/   | ||     \     ||     \      ||     \     ||___   |
|__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||_____|
    |_____|      |_____|      |_____|      |_____|

--[Mark3 Realtime Platform]--------------------------------------------------

Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
See license.txt for more information
===========================================================================*/
#include "kerneltypes.h"
#include "kerneltimer.h"

#include <avr/io.h>
#include <avr/interrupt.h>

#define TCCR1B_INIT     ((1 << WGM12) | (1 << CS12))
#define TIMER_IMSK      (1 << OCIE1A)
#define TIMER_IFR       (1 << OCF1A)

//---------------------------------------------------------------------------
void KernelTimer::Config(void)
{
    TCCR1B = TCCR1B_INIT;
}

//---------------------------------------------------------------------------
void KernelTimer::Start(void)
{
    TCNT1 = 0;
    TIFR1 &= ~TIMER_IFR;
    TIMSK1 |= TIMER_IMSK;
    TCCR1B |= (1 << CS12);      // Enable count...
```

```
00044 }
00045
00046 //---------------------------------------------------------------------------
00047 void KernelTimer::Stop(void)
00048 {
00049     TIFR1 &= ~TIMER_IFR;
00050     TIMSK1 &= ~TIMER_IMSK;
00051     TCCR1B &= ~(1 << CS12);      // Disable count...
00052     TCNT1 = 0;
00053     OCR1A = 0;
00054 }
00055
00056 //---------------------------------------------------------------------------
00057 K_USHORT KernelTimer::Read(void)
00058 {
00059     volatile K_USHORT usRead1;
00060     volatile K_USHORT usRead2;
00061
00062     do {
00063         usRead1 = TCNT1;
00064         usRead2 = TCNT1;
00065     } while (usRead1 != usRead2);
00066
00067     return usRead1;
00068 }
00069
00070 //---------------------------------------------------------------------------
00071 K_ULONG KernelTimer::SubtractExpiry(K_ULONG ulInterval_)
00072 {
00073     OCR1A -= (K_USHORT)ulInterval_;
00074     return (K_ULONG)OCR1A;
00075 }
00076
00077 //---------------------------------------------------------------------------
00078 K_ULONG KernelTimer::TimeToExpiry(void)
00079 {
00080     K_USHORT usRead = KernelTimer::Read();
00081     K_USHORT usOCR1A = OCR1A;
00082
00083     if (usRead >= usOCR1A)
00084     {
00085         return 0;
00086     }
00087     else
00088     {
00089         return (K_ULONG)(usOCR1A - usRead);
00090     }
00091 }
00092
00093 //---------------------------------------------------------------------------
00094 K_ULONG KernelTimer::GetOvertime(void)
00095 {
00096     return KernelTimer::Read();
00097 }
00098
00099 //---------------------------------------------------------------------------
00100 K_ULONG KernelTimer::SetExpiry(K_ULONG ulInterval_)
00101 {
00102     K_USHORT usSetInterval;
00103     if (ulInterval_ > 65535)
00104     {
00105         usSetInterval = 65535;
00106     }
00107     else
00108     {
00109         usSetInterval = (K_USHORT)ulInterval_ ;
00110     }
00111     OCR1A = usSetInterval;
00112     return (K_ULONG)usSetInterval;
00113 }
00114
00115 //---------------------------------------------------------------------------
00116 void KernelTimer::ClearExpiry(void)
00117 {
00118     OCR1A = 65535;                  // Clear the compare value
00119 }
00120
00121 //---------------------------------------------------------------------------
00122 K_UCHAR KernelTimer::DI(void)
00123 {
00124     K_UCHAR bEnabled = ((TIMSK1 & (TIMER_IMSK)) != 0);
00125     TIFR1 &= ~TIMER_IFR;       // Clear interrupt flags
00126     TIMSK1 &= ~TIMER_IMSK;     // Disable interrupt
00127     return bEnabled;
00128 }
00129
00130 //---------------------------------------------------------------------------
```

```
00131 void KernelTimer::EI(void)
00132 {
00133     KernelTimer::RI(0);
00134 }
00135
00136 //---------------------------------------------------------------------------
00137 void KernelTimer::RI(K_UCHAR bEnable_)
00138 {
00139     if (bEnable_)
00140     {
00141         TIMSK1 |= (1 << OCIE1A);    // Enable interrupt
00142     }
00143     else
00144     {
00145         TIMSK1 &= ~(1 << OCIE1A);
00146     }
00147 }
```

14.79 /home/moslevin2/mark3/embedded/stage/src/kerneltimer.h File Reference

Kernel Timer Class declaration.

```
#include "kerneltypes.h"
```

Classes

- class KernelTimer

  Hardware timer interface, used by all scheduling/timer subsystems.

Macros

- #define **SYSTEM_FREQ** ((K_ULONG)16000000)
- #define **TIMER_FREQ** ((K_ULONG)(SYSTEM_FREQ / 256))

14.79.1 Detailed Description

Kernel Timer Class declaration.

Definition in file kerneltimer.h.

14.80 kerneltimer.h

```
00001 /*===========================================================================
00002      _____          _____          _____          _____
00003  ___|    _|__   ___|_    |__   ___|__   |__   ___| __   |__   ______
00004 |    \  /  | ||    \       ||      |     ||  |/ /     ||___    |
00005 |     \/   | ||     \      ||      \     ||     \     ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00021 #include "kerneltypes.h"
00022 #ifndef __KERNELTIMER_H_
00023 #define __KERNELTIMER_H_
00024
00025 //---------------------------------------------------------------------------
00026 #define SYSTEM_FREQ     ((K_ULONG)16000000)
00027 #define TIMER_FREQ      ((K_ULONG)(SYSTEM_FREQ / 256)) // Timer ticks per second...
00028
00029 //---------------------------------------------------------------------------
00033 class KernelTimer
```

```
{
public:
    static void Config(void);

    static void Start(void);

    static void Stop(void);

    static K_UCHAR DI(void);

    static void RI(K_UCHAR bEnable_);

    static void EI(void);

    static K_ULONG SubtractExpiry(K_ULONG ulInterval_);

    static K_ULONG TimeToExpiry(void);

    static K_ULONG SetExpiry(K_ULONG ulInterval_);

    static K_ULONG GetOvertime(void);

    static void ClearExpiry(void);

private:
    static K_USHORT Read(void);

};

#endif //__KERNELTIMER_H_
```

14.81 /home/moslevin2/mark3/embedded/stage/src/kerneltypes.h File Reference

Basic data type primatives used throughout the OS.

```
#include <stdint.h>
```

Macros

- #define **K_BOOL** uint8_t
- #define **K_CHAR** char
- #define **K_UCHAR** uint8_t
- #define **K_USHORT** uint16_t
- #define **K_SHORT** int16_t
- #define **K_ULONG** uint32_t
- #define **K_LONG** int32_t
- #define **K_ADDR** uint32_t

14.81.1 Detailed Description

Basic data type primatives used throughout the OS.

Definition in file kerneltypes.h.

14.82 kerneltypes.h

```
/*===========================================================================
     _____     _____     _____     _____
 ___|    _|__  __|_    |__  __|__   |__  __| __  |__  _____
|    \  /  | ||    \     ||     |     ||  |/ /     ||___   |
|     \/   | ||     \    ||     \     ||     \     ||___   |
|__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||_____|
    |_____|      |_____|      |_____|      |_____|

--[Mark3 Realtime Platform]--------------------------------------------------

```

```
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===============================================================================*/
00019 #include <stdint.h>
00020
00021 #ifndef __KERNELTYPES_H__
00022 #define __KERNELTYPES_H__
00023
00024 #if defined(bool)
00025     #define K_BOOL          bool
00026 #else
00027     #define K_BOOL          uint8_t
00028 #endif
00029
00030 #define K_CHAR          char
00031 #define K_UCHAR         uint8_t
00032 #define K_USHORT        uint16_t
00033 #define K_SHORT         int16_t
00034 #define K_ULONG         uint32_t
00035 #define K_LONG          int32_t
00036
00037 #if !defined(K_ADDR)
00038     #define K_ADDR      uint32_t
00039 #endif
00040
00041
00042 #endif
```

14.83 /home/moslevin2/mark3/embedded/stage/src/keycodes.h File Reference

Standard ASCII keyboard codes.

```
#include "kerneltypes.h"
```

Enumerations

- enum **KEYCODE** {
  KEYCODE_LBUTTON = 0x01, **KEYCODE_RBUTTON**, **KEYCODE_CANCEL**, **KEYCODE_MBUTTON**,
  KEYCODE_BACK = 0x08, **KEYCODE_TAB**, **KEYCODE_CLEAR** = 0x0C, **KEYCODE_RETURN**,
  KEYCODE_SHIFT = 0x10, **KEYCODE_CONTROL**, **KEYCODE_MENU**, **KEYCODE_PAUSE**,
  KEYCODE_CAPITAL, **KEYCODE_ESCAPE** = 0x1B, **KEYCODE_SPACE**, **KEYCODE_PRIOR**,
  KEYCODE_NEXT, **KEYCODE_END**, **KEYCODE_HOME**, **KEYCODE_LEFT**,
  KEYCODE_UP, **KEYCODE_RIGHT**, **KEYCODE_DOWN**, **KEYCODE_SELECT**,
  KEYCODE_PRINT, **KEYCODE_EXECUTE**, **KEYCODE_SNAPSHOT**, **KEYCODE_INSERT**,
  KEYCODE_DELETE, **KEYCODE_HELP** = 0x2F, **KEYCODE_0**, **KEYCODE_1**,
  KEYCODE_2, **KEYCODE_3**, **KEYCODE_4**, **KEYCODE_5**,
  KEYCODE_6, **KEYCODE_7**, **KEYCODE_8**, **KEYCODE_9**,
  KEYCODE_A, **KEYCODE_B**, **KEYCODE_C**, **KEYCODE_D**,
  KEYCODE_E, **KEYCODE_F**, **KEYCODE_G**, **KEYCODE_H**,
  KEYCODE_I, **KEYCODE_J**, **KEYCODE_K**, **KEYCODE_L**,
  KEYCODE_M, **KEYCODE_N**, **KEYCODE_O**, **KEYCODE_P**,
  KEYCODE_Q, **KEYCODE_R**, **KEYCODE_S**, **KEYCODE_T**,
  KEYCODE_U, **KEYCODE_V**, **KEYCODE_W**, **KEYCODE_X**,
  KEYCODE_Y, **KEYCODE_Z**, **KEYCODE_NUMPAD0** = 0x60, **KEYCODE_NUMPAD1**,
  KEYCODE_NUMPAD2, **KEYCODE_NUMPAD3**, **KEYCODE_NUMPAD4**, **KEYCODE_NUMPAD5**,
  KEYCODE_NUMPAD6, **KEYCODE_NUMPAD7**, **KEYCODE_NUMPAD8**, **KEYCODE_NUMPAD9**,
  KEYCODE_SEPARATOR = 0x6C, **KEYCODE_SUBTRACT**, **KEYCODE_DECIMAL**, **KEYCODE_DIVIDE**,
  KEYCODE_F1, **KEYCODE_F2**, **KEYCODE_F3**, **KEYCODE_F4**,
  KEYCODE_F5, **KEYCODE_F6**, **KEYCODE_F7**, **KEYCODE_F8**,
  KEYCODE_F9, **KEYCODE_F10**, **KEYCODE_F11**, **KEYCODE_F12**,
  KEYCODE_F13, **KEYCODE_F14**, **KEYCODE_F15**, **KEYCODE_F16**,
  KEYCODE_F17, **KEYCODE_F18**, **KEYCODE_F19**, **KEYCODE_F20**,
  KEYCODE_F21, **KEYCODE_F22**, **KEYCODE_F23**, **KEYCODE_F24**,
  KEYCODE_NUMLOCK = 0x90, **KEYCODE_SCROLL**, **KEYCODE_LSHIFT** = 0xA0, **KEYCODE_RSHIFT**,
  KEYCODE_LCONTROL, **KEYCODE_RCONTROL**, **KEYCODE_LMENU**, **KEYCODE_RMENU**,
  KEYCODE_PLAY = 0xFA, **KEYCODE_ZOOM** }

14.83.1 Detailed Description

Standard ASCII keyboard codes.

Definition in file keycodes.h.

14.84 keycodes.h

```
00001 /*===========================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__   ____|_    |__   ____|__    |__   ____| __   |__   ______
00004 |    \  /   | ||    \       ||      |     ||   |/ /     ||___    |
00005 |     \/    | ||     \      ||      \     ||     \      ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007    |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00020 #ifndef __KEYCODES_H_
00021 #define __KEYCODES_H_
00022
00023 #include "kerneltypes.h"
00024
00025 typedef enum
00026 {
00027     KEYCODE_LBUTTON = 0x01,
00028     KEYCODE_RBUTTON,
00029     KEYCODE_CANCEL,
```

```
00030     KEYCODE_MBUTTON,
00031     KEYCODE_BACK = 0x08,
00032     KEYCODE_TAB,
00033     KEYCODE_CLEAR = 0x0C,
00034     KEYCODE_RETURN,
00035     KEYCODE_SHIFT = 0x10,
00036     KEYCODE_CONTROL,
00037     KEYCODE_MENU,
00038     KEYCODE_PAUSE,
00039     KEYCODE_CAPITAL,
00040     KEYCODE_ESCAPE = 0x1B,
00041     KEYCODE_SPACE,
00042     KEYCODE_PRIOR,
00043     KEYCODE_NEXT,
00044     KEYCODE_END,
00045     KEYCODE_HOME,
00046     KEYCODE_LEFT,
00047     KEYCODE_UP,
00048     KEYCODE_RIGHT,
00049     KEYCODE_DOWN,
00050     KEYCODE_SELECT,
00051     KEYCODE_PRINT,
00052     KEYCODE_EXECUTE,
00053     KEYCODE_SNAPSHOT,
00054     KEYCODE_INSERT,
00055     KEYCODE_DELETE,
00056     KEYCODE_HELP = 0x2F,
00057     KEYCODE_0,
00058     KEYCODE_1,
00059     KEYCODE_2,
00060     KEYCODE_3,
00061     KEYCODE_4,
00062     KEYCODE_5,
00063     KEYCODE_6,
00064     KEYCODE_7,
00065     KEYCODE_8,
00066     KEYCODE_9,
00067     KEYCODE_A,
00068     KEYCODE_B,
00069     KEYCODE_C,
00070     KEYCODE_D,
00071     KEYCODE_E,
00072     KEYCODE_F,
00073     KEYCODE_G,
00074     KEYCODE_H,
00075     KEYCODE_I,
00076     KEYCODE_J,
00077     KEYCODE_K,
00078     KEYCODE_L,
00079     KEYCODE_M,
00080     KEYCODE_N,
00081     KEYCODE_O,
00082     KEYCODE_P,
00083     KEYCODE_Q,
00084     KEYCODE_R,
00085     KEYCODE_S,
00086     KEYCODE_T,
00087     KEYCODE_U,
00088     KEYCODE_V,
00089     KEYCODE_W,
00090     KEYCODE_X,
00091     KEYCODE_Y,
00092     KEYCODE_Z,
00093     KEYCODE_NUMPAD0 = 0x60,
00094     KEYCODE_NUMPAD1,
00095     KEYCODE_NUMPAD2,
00096     KEYCODE_NUMPAD3,
00097     KEYCODE_NUMPAD4,
00098     KEYCODE_NUMPAD5,
00099     KEYCODE_NUMPAD6,
00100     KEYCODE_NUMPAD7,
00101     KEYCODE_NUMPAD8,
00102     KEYCODE_NUMPAD9,
00103     KEYCODE_SEPARATOR = 0x6C,
00104     KEYCODE_SUBTRACT,
00105     KEYCODE_DECIMAL,
00106     KEYCODE_DIVIDE,
00107     KEYCODE_F1,
00108     KEYCODE_F2,
00109     KEYCODE_F3,
00110     KEYCODE_F4,
00111     KEYCODE_F5,
00112     KEYCODE_F6,
00113     KEYCODE_F7,
00114     KEYCODE_F8,
00115     KEYCODE_F9,
00116     KEYCODE_F10,
```

```
    KEYCODE_F11,
    KEYCODE_F12,
    KEYCODE_F13,
    KEYCODE_F14,
    KEYCODE_F15,
    KEYCODE_F16,
    KEYCODE_F17,
    KEYCODE_F18,
    KEYCODE_F19,
    KEYCODE_F20,
    KEYCODE_F21,
    KEYCODE_F22,
    KEYCODE_F23,
    KEYCODE_F24,
    KEYCODE_NUMLOCK = 0x90,
    KEYCODE_SCROLL,
    KEYCODE_LSHIFT = 0xA0,
    KEYCODE_RSHIFT,
    KEYCODE_LCONTROL,
    KEYCODE_RCONTROL,
    KEYCODE_LMENU,
    KEYCODE_RMENU,
    KEYCODE_PLAY = 0xFA,
    KEYCODE_ZOOM
} KEYCODE;

#endif //__KEYCODES_H_
```

14.85 /home/moslevin2/mark3/embedded/stage/src/kprofile.cpp File Reference

ATMega328p Profiling timer implementation.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "profile.h"
#include "kprofile.h"
#include "threadport.h"
#include <avr/io.h>
#include <avr/interrupt.h>
```

Functions

- **ISR** (TIMER0_OVF_vect)

14.85.1 Detailed Description

ATMega328p Profiling timer implementation.

Definition in file kprofile.cpp.

14.86 kprofile.cpp

```
/*===========================================================================
     _____     _____     _____     _____
 ___|    _|__ __|_    |__ __|__   |__ __| __  |__ _____
|    \  /  | ||    \     ||     |     ||  |/ /     ||___   |
|     \/   | ||     \    ||      \    ||    \      ||___   |
|__/\__/|__|_||__|\__\ __||__|\__\ __||__|\__\ __||_____|
    |_____|      |_____|      |_____|     |_____|

--[Mark3 Realtime Platform]--------------------------------------------------

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===========================================================================*/
#include "kerneltypes.h"
#include "mark3cfg.h"
```

```
00022 #include "profile.h"
00023 #include "kprofile.h"
00024 #include "threadport.h"
00025 #include <avr/io.h>
00026 #include <avr/interrupt.h>
00027
00028 #if KERNEL_USE_PROFILER
00029 K_ULONG Profiler::m_ulEpoch;
00030
00031 //---------------------------------------------------------------------------
00032 void Profiler::Init()
00033 {
00034     TCCR0A = 0;
00035     TCCR0B = 0;
00036     TIFR0 = 0;
00037     TIMSK0 = 0;
00038     m_ulEpoch = 0;
00039 }
00040
00041 //---------------------------------------------------------------------------
00042 void Profiler::Start()
00043 {
00044     TIFR0 = 0;
00045     TCNT0 = 0;
00046     TCCR0B |= (1 << CS01);
00047     TIMSK0 |= (1 << TOIE0);
00048 }
00049
00050 //---------------------------------------------------------------------------
00051 void Profiler::Stop()
00052 {
00053     TIFR0 = 0;
00054     TCCR0B &= ~(1 << CS01);
00055     TIMSK0 &= ~(1 << TOIE0);
00056 }
00057 //---------------------------------------------------------------------------
00058 K_USHORT Profiler::Read()
00059 {
00060     K_USHORT usRet;
00061     CS_ENTER();
00062     TCCR0B &= ~(1 << CS01);
00063     usRet = TCNT0;
00064     TCCR0B |= (1 << CS01);
00065     CS_EXIT();
00066     return usRet;
00067 }
00068
00069 //---------------------------------------------------------------------------
00070 void Profiler::Process()
00071 {
00072     CS_ENTER();
00073     m_ulEpoch++;
00074     CS_EXIT();
00075 }
00076
00077 //---------------------------------------------------------------------------
00078 ISR(TIMER0_OVF_vect)
00079 {
00080     Profiler::Process();
00081 }
00082
00083 #endif
```

14.87 /home/moslevin2/mark3/embedded/stage/src/kprofile.h File Reference

Profiling timer hardware interface.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "ll.h"
```

Classes

- class Profiler

  System profiling timer interface.

Macros

- #define **TICKS_PER_OVERFLOW** (256)
- #define **CLOCK_DIVIDE** (8)

14.87.1 Detailed Description

Profiling timer hardware interface.

Definition in file kprofile.h.

14.88 kprofile.h

```
/*===========================================================================
     _____     _____     _____     _____
 ___|    _|__  __|_    |__  __|__  |__  __| __  |__  _____
|    \  /  | ||    \     ||     |     ||  |/ /     ||___   |
|     \/   | ||     \    ||     \     ||  |  \     ||___   |
|__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||_____|
    |_____|      |_____|      |_____|      |_____|

--[Mark3 Realtime Platform]--------------------------------------------------

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See license.txt for more information
===========================================================================*/
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "ll.h"

#ifndef __KPROFILE_H__
#define __KPROFILE_H__

#if KERNEL_USE_PROFILER

//---------------------------------------------------------------------------
#define TICKS_PER_OVERFLOW              (256)
#define CLOCK_DIVIDE                    (8)

//---------------------------------------------------------------------------
class Profiler
{
public:
    static void Init();

    static void Start();

    static void Stop();

    static K_USHORT Read();

    static void Process();

    static K_ULONG GetEpoch(){ return m_ulEpoch; }
private:

    static K_ULONG m_ulEpoch;
};

#endif //KERNEL_USE_PROFILER

#endif

```

14.89 /home/moslevin2/mark3/embedded/stage/src/ksemaphore.cpp File Reference

Semaphore Blocking-Object Implemenation.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "ksemaphore.h"
#include "blocking.h"
#include "kernel_debug.h"
#include "timerlist.h"
```

Macros

- #define **__FILE_ID__** SEMAPHORE_CPP

Functions

- void **TimedSemaphore_Callback** (Thread *pclOwner_, void *pvData_)

14.89.1 Detailed Description

Semaphore Blocking-Object Implemenation.

Definition in file ksemaphore.cpp.

14.90 ksemaphore.cpp

```
00001 /*===========================================================================
00002      _____          _____          _____          _____
00003  ___|    _|__   ___|_    |__   ___|__   |__   ___| __   |__   ______
00004 |    \  /  | ||    \       ||      |     ||  |/ /     ||___    |
00005 |     \/   | ||     \      ||      \     ||     \     ||___    |
00006 |__/\__/|__|_||__|\__\  ___||__|\__\  ___||__|\__\  ___||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00022 #include "kerneltypes.h"
00023 #include "mark3cfg.h"
00024
00025 #include "ksemaphore.h"
00026 #include "blocking.h"
00027 #include "kernel_debug.h"
00028 //---------------------------------------------------------------------------
00029 #if defined __FILE_ID__
00030     #undef __FILE_ID__
00031 #endif
00032 #define __FILE_ID__     SEMAPHORE_CPP
00033
00034 #if KERNEL_USE_SEMAPHORE
00035
00036 #if KERNEL_USE_TIMERS
00037 #include "timerlist.h"
00038
00039 //---------------------------------------------------------------------------
00040 void TimedSemaphore_Callback(Thread *pclOwner_, void *pvData_)
00041 {
00042     Semaphore *pclSemaphore = static_cast<Semaphore*>(pvData_);
00043
00044     // Indicate that the semaphore has expired on the thread
00045     pclSemaphore->SetExpired(true);
00046
00047     // Wake up the thread that was blocked on this semaphore.
00048     pclSemaphore->WakeMe(pclOwner_);
00049
00050     if (pclOwner_->GetPriority() > Scheduler::GetCurrentThread()->
    GetPriority())
00051     {
00052         Thread::Yield();
00053     }
```

```
00054 }
00055
00056 //---------------------------------------------------------------------------
00057 void Semaphore::WakeMe(Thread *pclChosenOne_)
00058 {
00059     // Remove from the semaphore waitlist and back to its ready list.
00060     UnBlock(pclChosenOne_);
00061 }
00062
00063 #endif // KERNEL_USE_TIMERS
00064
00065 //---------------------------------------------------------------------------
00066 K_UCHAR Semaphore::WakeNext()
00067 {
00068     Thread *pclChosenOne;
00069
00070     pclChosenOne = m_clBlockList.HighestWaiter();
00071
00072     // Remove from the semaphore waitlist and back to its ready list.
00073     UnBlock(pclChosenOne);
00074
00075     // Call a task switch only if higher priority thread
00076     if (pclChosenOne->GetPriority() > Scheduler::GetCurrentThread()->
    GetPriority())
00077     {
00078         return 1;
00079     }
00080     return 0;
00081 }
00082
00083 //---------------------------------------------------------------------------
00084 void Semaphore::Init(K_USHORT usInitVal_, K_USHORT usMaxVal_)
00085 {
00086     // Copy the paramters into the object - set the maximum value for this
00087     // semaphore to implement either binary or counting semaphores, and set
00088     // the initial count.  Clear the wait list for this object.
00089     m_usValue = usInitVal_;
00090     m_usMaxValue = usMaxVal_;
00091 #if KERNEL_USE_TIMERS
00092     m_bExpired = false;
00093 #endif
00094     m_clBlockList.Init();
00095 }
00096
00097 //---------------------------------------------------------------------------
00098 bool Semaphore::Post()
00099 {
00100     KERNEL_TRACE_1( STR_SEMAPHORE_POST_1, (K_USHORT)g_pstCurrent->GetID() );
00101
00102     K_UCHAR bThreadWake = 0;
00103     K_BOOL bBail = false;
00104     // Increment the semaphore count - we can mess with threads so ensure this
00105     // is in a critical section.  We don't just disable the scheudler since
00106     // we want to be able to do this from within an interrupt context as well.
00107     CS_ENTER();
00108
00109     // If nothing is waiting for the semaphore
00110     if (m_clBlockList.GetHead() == NULL)
00111     {
00112         // Check so see if we've reached the maximum value in the semaphore
00113         if (m_usValue < m_usMaxValue)
00114         {
00115             // Increment the count value
00116             m_usValue++;
00117         }
00118         else
00119         {
00120             // Maximum value has been reached, bail out.
00121             bBail = true;
00122         }
00123     }
00124     else
00125     {
00126         // Otherwise, there are threads waiting for the semaphore to be
00127         // posted, so wake the next one (highest priority goes first).
00128         bThreadWake = WakeNext();
00129     }
00130
00131     CS_EXIT();
00132
00133     // If we weren't able to increment the semaphore count, fail out.
00134     if (bBail)
00135     {
00136         return false;
00137     }
00138
00139     // if bThreadWake was set, it means that a higher-priority thread was
```

```
00140     // woken.  Trigger a context switch to ensure that this thread gets
00141     // to execute next.
00142     if (bThreadWake)
00143     {
00144         Thread::Yield();
00145     }
00146     return true;
00147 }
00148
00149 #if !KERNEL_USE_TIMERS
00150 //---------------------------------------------------------------------------
00151     // No timers, no timed pend
00152     void Semaphore::Pend()
00153 #else
00154 //---------------------------------------------------------------------------
00155     // Redirect the untimed pend API to the timed pend, with a null timeout.
00156     void Semaphore::Pend()
00157     {
00158         Pend(0);
00159     }
00160 //---------------------------------------------------------------------------
00161     bool Semaphore::Pend( K_ULONG ulWaitTimeMS_ )
00162 #endif
00163 {
00164     KERNEL_TRACE_1( STR_SEMAPHORE_PEND_1, (K_USHORT)g_pstCurrent->GetID() );
00165
00166     // Decrement the semaphore count - if 0, wait.
00167     K_UCHAR bThreadWait = 0;
00168
00169 #if KERNEL_USE_TIMERS
00170     Timer clSemTimer;
00171
00172     m_bExpired = false;
00173 #endif
00174
00175     // Once again, messing with thread data - ensure
00176     // we're doing all of these operations from within a thread-safe context.
00177     CS_ENTER();
00178
00179     // Check to see if we need to take any action based on the semaphore count
00180     if (m_usValue != 0)
00181     {
00182         // The semaphore count is non-zero, we can just decrement the count
00183         // and go along our merry way.
00184         m_usValue--;
00185     }
00186     else
00187     {
00188         Thread *pclThread;
00189
00190         // Get the current thread pointer.
00191         pclThread = Scheduler::GetCurrentThread();
00192
00193         // The semaphore count is zero - we need to block the current thread
00194         // and wait until the semaphore is posted from elsewhere.
00195 #if KERNEL_USE_TIMERS
00196         if (ulWaitTimeMS_)
00197         {
00198             clSemTimer.Start(0, ulWaitTimeMS_, TimedSemaphore_Callback, (void*)this);
00199         }
00200 #endif
00201         Block(pclThread);
00202         bThreadWait = 1;
00203     }
00204
00205     // If bThreadWait was set, it means that the current thread is blocked.
00206     // We need to call a context switch to ensure the highest-priority
00207     // ready thread gets to run next.
00208     if (bThreadWait)
00209     {
00210         // Switch Threads immediately
00211         Thread::Yield();
00212     }
00213
00214     CS_EXIT();
00215
00216
00217 #if KERNEL_USE_TIMERS
00218     if (ulWaitTimeMS_ && bThreadWait)
00219     {
00220         clSemTimer.Stop();
00221     }
00222     return (m_bExpired == 0);
00223 #endif
00224 }
00225
00226 //---------------------------------------------------------------------------
```

```
00227 K_USHORT Semaphore::GetCount()
00228 {
00229     K_USHORT usRet;
00230     CS_ENTER();
00231     usRet = m_usValue;
00232     CS_EXIT();
00233     return usRet;
00234 }
00235
00236 #endif
```

14.91 /home/moslevin2/mark3/embedded/stage/src/ksemaphore.h File Reference

Semaphore Blocking Object class declarations.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "blocking.h"
#include "threadlist.h"
```

Classes

- class Semaphore

  Counting semaphore, based on BlockingObject base class.

14.91.1 Detailed Description

Semaphore Blocking Object class declarations.

Definition in file ksemaphore.h.

14.92 ksemaphore.h

```
00001 /*===========================================================================
00002      _____        _____        _____        _____
00003  ___|    _|__  __|_    |__  __|__   |__  __| __  |__  ______
00004 |    \  /  | ||    \       ||      |     ||  |/ /     ||___   |
00005 |     \/   | ||     \      ||      \     ||     \     ||___   |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]-----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00022 #ifndef __KSEMAPHORE_H__
00023 #define __KSEMAPHORE_H__
00024
00025 #include "kerneltypes.h"
00026 #include "mark3cfg.h"
00027
00028 #include "blocking.h"
00029 #include "threadlist.h"
00030
00031 #if KERNEL_USE_SEMAPHORE
00032
00033 //---------------------------------------------------------------------------
00037 class Semaphore : public BlockingObject
00038 {
00039 public:
00049     void Init(K_USHORT usInitVal_, K_USHORT usMaxVal_);
00050
00059     bool Post();
00060
00067     void Pend();
00068
00069
```

```
00081     K_USHORT GetCount();
00082
00083 #if KERNEL_USE_TIMERS
00084
00095     bool Pend( K_ULONG ulWaitTimeMS_);
00096
00107     void WakeMe(Thread *pclChosenOne_);
00108
00115     void SetExpired(bool bExpired_) { m_bExpired = bExpired_; }
00116
00117     bool GetExpired() { return m_bExpired; }
00118 #endif
00119
00120 private:
00121
00127     K_UCHAR WakeNext();
00128
00129     K_USHORT m_usValue;
00130     K_USHORT m_usMaxValue;
00131
00132 #if KERNEL_USE_TIMERS
00133     bool m_bExpired;
00134 #endif
00135
00136 };
00137
00138 #endif //KERNEL_USE_SEMAPHORE
00139
00140 #endif
```

14.93 /home/moslevin2/mark3/embedded/stage/src/ll.cpp File Reference

Core Linked-List implementation, from which all kernel objects are derived.

```
#include "kerneltypes.h"
#include "ll.h"
#include "kernel_debug.h"
```

Macros

- #define **__FILE_ID__** LL_CPP

14.93.1 Detailed Description

Core Linked-List implementation, from which all kernel objects are derived.

Definition in file ll.cpp.

14.94 ll.cpp

```
00001 /*===========================================================================
00002       _____          _____          _____          _____
00003  ___|    _|__   ___|_    |__   ___|__    |__   ___| __   |__   ______
00004 |    \  /   | ||    \       ||       |     ||   |/ /      ||___    |
00005 |     \/    | ||     \      ||       \     ||      \      ||___    |
00006 |__/\__/|__|_||__|\__\   __||__|\__\   __||__|\__\   __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00022 #include "kerneltypes.h"
00023 #include "ll.h"
00024 #include "kernel_debug.h"
00025
00026 //---------------------------------------------------------------------------
00027 #if defined __FILE_ID__
```

```
00028     #undef __FILE_ID__
00029 #endif
00030 #define __FILE_ID__     LL_CPP
00031
00032 //---------------------------------------------------------------------------
00033 void LinkListNode::ClearNode()
00034 {
00035     next = NULL;
00036     prev = NULL;
00037 }
00038
00039 //---------------------------------------------------------------------------
00040 void DoubleLinkList::Add(LinkListNode *node_)
00041 {
00042     KERNEL_ASSERT( node_ );
00043
00044     // Add a node to the end of the linked list.
00045     if (!m_pstHead)
00046     {
00047         // If the list is empty, initilize the nodes
00048         m_pstHead = node_;
00049         m_pstTail = node_;
00050
00051         m_pstHead->prev = NULL;
00052         m_pstTail->next = NULL;
00053         return;
00054     }
00055
00056     // Move the tail node, and assign it to the new node just passed in
00057     m_pstTail->next = node_;
00058     node_->prev = m_pstTail;
00059     node_->next = NULL;
00060     m_pstTail = node_;
00061 }
00062
00063 //---------------------------------------------------------------------------
00064 void DoubleLinkList::Remove(LinkListNode *node_)
00065 {
00066     KERNEL_ASSERT( node_ );
00067
00068     if (node_->prev)
00069     {
00070         node_->prev->next = node_->next;
00071     }
00072     if (node_->next)
00073     {
00074         node_->next->prev = node_->prev;
00075     }
00076     if (node_ == m_pstHead)
00077     {
00078         m_pstHead = node_->next;
00079     }
00080     if (node_ == m_pstTail)
00081     {
00082         m_pstTail = node_->prev;
00083     }
00084
00085     node_->ClearNode();
00086 }
00087
00088 //---------------------------------------------------------------------------
00089 void CircularLinkList::Add(LinkListNode *node_)
00090 {
00091     KERNEL_ASSERT( node_ );
00092
00093     // Add a node to the end of the linked list.
00094     if (!m_pstHead)
00095     {
00096         // If the list is empty, initilize the nodes
00097         m_pstHead = node_;
00098         m_pstTail = node_;
00099
00100         m_pstHead->prev = m_pstHead;
00101         m_pstHead->next = m_pstHead;
00102         return;
00103     }
00104
00105     // Move the tail node, and assign it to the new node just passed in
00106     m_pstTail->next = node_;
00107     node_->prev = m_pstTail;
00108     node_->next = m_pstHead;
00109     m_pstTail = node_;
00110     m_pstHead->prev = node_;
00111 }
00112
00113 //---------------------------------------------------------------------------
00114 void CircularLinkList::Remove(LinkListNode *node_)
```

```
00115 {
00116     KERNEL_ASSERT( node_ );
00117 
00118     // Check to see if this is the head of the list...
00119     if ((node_ == m_pstHead) && (m_pstHead == m_pstTail))
00120     {
00121         // Clear the head and tail pointers - nothing else left.
00122         m_pstHead = NULL;
00123         m_pstTail = NULL;
00124         return;
00125     }
00126 
00127     // This is a circularly linked list - no need to check for connection,
00128     // just remove the node.
00129     node_->next->prev = node_->prev;
00130     node_->prev->next = node_->next;
00131 
00132     if (node_ == m_pstHead)
00133     {
00134         m_pstHead = m_pstHead->next;
00135     }
00136     if (node_ == m_pstTail)
00137     {
00138         m_pstTail = m_pstTail->prev;
00139     }
00140     node_->ClearNode();
00141 }
00142 
00143 //---------------------------------------------------------------------------
00144 void CircularLinkList::PivotForward()
00145 {
00146     if (m_pstHead)
00147     {
00148         m_pstHead = m_pstHead->next;
00149         m_pstTail = m_pstTail->next;
00150     }
00151 }
00152 
00153 //---------------------------------------------------------------------------
00154 void CircularLinkList::PivotBackward()
00155 {
00156     if (m_pstHead)
00157     {
00158         m_pstHead = m_pstHead->prev;
00159         m_pstTail = m_pstTail->prev;
00160     }
00161 }
```

14.95 /home/moslevin2/mark3/embedded/stage/src/ll.h File Reference

Core linked-list declarations, used by all kernel list types.

```
#include "kerneltypes.h"
```

Classes

- class LinkListNode

  Basic linked-list node data structure.
- class LinkList

  Abstract-data-type from which all other linked-lists are derived.
- class DoubleLinkList

  Doubly-linked-list data type, inherited from the base LinkList type.
- class CircularLinkList

  Circular-linked-list data type, inherited from the base LinkList type.

Macros

- #define **NULL** (0)
- #define SAFE_UNLINK (0)

"Safe unlinking" performs extra checks on data to make sure that there are no consistencies when performing node operations.

14.95.1 Detailed Description

Core linked-list declarations, used by all kernel list types. At the heart of RTOS data structures are linked lists. Having a robust and efficient set of linked-list types that we can use as a foundation for building the rest of our kernel types allows us to keep our RTOS code efficient and logically-separated.

So what data types rely on these linked-list classes?

-Threads -ThreadLists -The Scheduler -Timers, -The Timer Scheduler -Blocking objects (Semaphores, Mutexes, etc...)

Pretty much everything in the kernel uses these linked lists. By having objects inherit from the base linked-list node type, we're able to leverage the double and circular linked-list classes to manager virtually every object type in the system without duplicating code. These functions are very efficient as well, allowing for very deterministic behavior in our code.

Definition in file ll.h.

14.96 ll.h

```
00001 /*=========================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__   ____|_    |__   ____|__    |__   ____| __   |__   ______
00004 |    \   /   | ||    \       ||      |      ||   |/ /      ||___    |
00005 |     \/    | ||     \      ||      \      ||      \      ||___    |
00006 |__/\__/|__|_||__|\__\   __||__|\__\   __||__|\__\   __||______|
00007    |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00043 #ifndef __LL_H__
00044 #define __LL_H__
00045
00046 #include "kerneltypes.h"
00047
00048 //---------------------------------------------------------------------------
00049 #ifndef NULL
00050 #define NULL        (0)
00051 #endif
00052
00053 //---------------------------------------------------------------------------
00058 #define SAFE_UNLINK     (0)
00059
00060 //---------------------------------------------------------------------------
00066 class LinkList;
00067 class DoubleLinkList;
00068 class CircularLinkList;
00069
00070 //---------------------------------------------------------------------------
00075 class LinkListNode
00076 {
00077 protected:
00078
00079     LinkListNode *next;
00080     LinkListNode *prev;
00081
00087     void ClearNode();
00088
00089 public:
00097     LinkListNode *GetNext(void) { return next; }
00098
00106     LinkListNode *GetPrev(void) { return prev; }
00107
00108     friend class LinkList;
00109     friend class DoubleLinkList;
00110     friend class CircularLinkList;
00111 };
00112
00113 //---------------------------------------------------------------------------
```

```
00117 class LinkList
00118 {
00119 protected:
00120     LinkListNode *m_pstHead;
00121     LinkListNode *m_pstTail;
00122
00123 public:
00127     void Init(){ m_pstHead = NULL; m_pstTail = NULL; }
00128
00136     virtual void Add(LinkListNode *node_) = 0;
00137
00145     virtual void Remove(LinkListNode *node_) = 0;
00146
00154     LinkListNode *GetHead() { return m_pstHead; }
00155
00163     LinkListNode *GetTail() { return m_pstTail; }
00164 };
00165
00166 //---------------------------------------------------------------------------
00170 class DoubleLinkList : public LinkList
00171 {
00172 public:
00176     DoubleLinkList() { m_pstHead = NULL; m_pstTail = NULL; }
00177
00185     virtual void Add(LinkListNode *node_);
00186
00194     virtual void Remove(LinkListNode *node_);
00195 };
00196
00197 //---------------------------------------------------------------------------
00201 class CircularLinkList : public LinkList
00202 {
00203 public:
00204     CircularLinkList() { m_pstHead = NULL; m_pstTail = NULL; }
00205
00213     virtual void Add(LinkListNode *node_);
00214
00222     virtual void Remove(LinkListNode *node_);
00223
00230     void PivotForward();
00231
00238     void PivotBackward();
00239 };
00240
00241 #endif
```

14.97 /home/moslevin2/mark3/embedded/stage/src/manual.h File Reference

Ascii-format documentation, used by doxygen to create various printable and viewable forms.

14.97.1 Detailed Description

Ascii-format documentation, used by doxygen to create various printable and viewable forms.

Definition in file manual.h.

14.98 manual.h

```
00001 /*===========================================================================
00002
00003
00004
00005
00006
00007
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
```

14.99 /home/moslevin2/mark3/embedded/stage/src/mark3cfg.h File Reference

Mark3 Kernel Configuration.

Macros

- #define KERNEL_USE_TIMERS (1)

  The following options is related to all kernel time-tracking.
- #define KERNEL_USE_QUANTUM (1)

  Do you want to enable time quanta? This is useful when you want to have tasks in the same priority group share time in a controlled way.
- #define KERNEL_USE_SEMAPHORE (1)

  Do you want the ability to use counting/binary semaphores for thread synchronization? Enabling this features provides fully-blocking semaphores and enables all API functions declared in semaphore.h.
- #define KERNEL_USE_MESSAGE (1)

  Enable inter-thread messaging using named mailboxes.
- #define GLOBAL_MESSAGE_POOL_SIZE (8)

  If Messages are enabled, define the size of the default kernel message pool.
- #define KERNEL_USE_MUTEX (1)

  Do you want the ability to use mutual exclusion semaphores (mutex) for resource/block protection? Enabling this feature provides mutexes, with priority inheritence, as declared in mutex.h.
- #define KERNEL_USE_SLEEP (1)

  Do you want to be able to set threads to sleep for a specified time? This enables the Thread::Sleep() API.
- #define KERNEL_USE_DRIVER (1)

  Enabling device drivers provides a posix-like filesystem interface for peripheral device drivers.
- #define KERNEL_USE_THREADNAME (1)

  Provide Thread method to allow the user to set a name for each thread in the system.
- #define KERNEL_USE_DYNAMIC_THREADS (1)

  Provide extra Thread methods to allow the application to create (and more importantly destroy) threads at runtime.
- #define KERNEL_USE_PROFILER (1)

  Provides extra classes for profiling the performance of code.
- #define KERNEL_USE_DEBUG (0)

  Provides extra logic for kernel debugging, and instruments the kernel with extra asserts, and kernel trace functionality.

14.99.1 Detailed Description

Mark3 Kernel Configuration. This file is used to configure the kernel for your specific application in order to provide the optimal set of features for a given use case.

Since you only pay the price (code space/RAM) for the features you use, you can usually find a sweet spot between features and resource usage by picking and choosing features a-la-carte. This config file is written in an "interactive" way, in order to minimize confusion about what each option provides, and to make dependencies obvious.

As of 7.6.2012 on AVR, these are the costs associated with the various features:

Base Kernel: 2888 bytes Tickless Timers: 1194 bytes Semaphores: 224 bytes Message Queues: 332 bytes (+ Semaphores) Mutexes: 290 bytes Thread Sleep: 162 bytes (+ Semaphores/Timers) Round-Robin: 304 bytes (+ Timers) Drivers: 144 bytes Dynamic Threads: 68 bytes Thread Names: 8 bytes Profiling Timers: 624 bytes

Definition in file mark3cfg.h.

14.99.2 Macro Definition Documentation

14.99.2.1 #define GLOBAL_MESSAGE_POOL_SIZE (8)

If Messages are enabled, define the size of the default kernel message pool.

Messages can be manually added to the message pool, but this mechansims is more convenient and automatic.

Definition at line 99 of file mark3cfg.h.

14.99.2.2 #define KERNEL_USE_DRIVER (1)

Enabling device drivers provides a posix-like filesystem interface for peripheral device drivers.

When enabled, the size of the filesystem table is specified in DRIVER_TABLE_SIZE. Permissions are enforced for driver access by thread ID and group when DRIVER_USE_PERMS are enabled.

Definition at line 127 of file mark3cfg.h.

14.99.2.3 #define KERNEL_USE_DYNAMIC_THREADS (1)

Provide extra Thread methods to allow the application to create (and more importantly destroy) threads at runtime.

Useful for designs implementing worker threads, or threads that can be restarted after encountering error conditions.

Definition at line 142 of file mark3cfg.h.

14.99.2.4 #define KERNEL_USE_MESSAGE (1)

Enable inter-thread messaging using named mailboxes.

If per-thread mailboxes are defined, each thread is allocated a default mailbox of a depth specified by THREAD_MAILBOX_SIZE.

Definition at line 88 of file mark3cfg.h.

14.99.2.5 #define KERNEL_USE_MUTEX (1)

Do you want the ability to use mutual exclusion semaphores (mutex) for resource/block protection? Enabling this feature provides mutexes, with priority inheritence, as declared in mutex.h.

Enabling per-thread mutex automatically allocates a mutex for each thread.

Definition at line 108 of file mark3cfg.h.

14.99.2.6 #define KERNEL_USE_PROFILER (1)

Provides extra classes for profiling the performance of code.

Useful for debugging and development, but uses an additional timer.

Definition at line 148 of file mark3cfg.h.

14.99.2.7 #define KERNEL_USE_QUANTUM (1)

Do you want to enable time quanta? This is useful when you want to have tasks in the same priority group share time in a controlled way.

This allows equal tasks to use unequal amounts of the CPU, which is a great way to set up CPU budgets per thread in a round-robin scheduling system. If enabled, you can specify a number of ticks that serves as the default time period (quantum). Unless otherwise specified, every thread in a priority will get the default quantum.

Definition at line 68 of file mark3cfg.h.

14.99.2.8 #define KERNEL_USE_SEMAPHORE (1)

Do you want the ability to use counting/binary semaphores for thread synchronization? Enabling this features provides fully-blocking semaphores and enables all API functions declared in semaphore.h.

If you have to pick one blocking mechanism, this is the one to choose. By also enabling per-thread semaphores, each thread will receive it's own built-in semaphore.

Definition at line 80 of file mark3cfg.h.

14.99.2.9 #define KERNEL_USE_THREADNAME (1)

Provide Thread method to allow the user to set a name for each thread in the system.

Adds to the size of the thread member data.

Definition at line 134 of file mark3cfg.h.

14.99.2.10 #define KERNEL_USE_TIMERS (1)

The following options is related to all kernel time-tracking.

-timers provide a way for events to be periodically triggered in a lightweight manner. These can be periodic, or one-shot.

-Thread Quantum (used for round-robin scheduling) is dependent on this module, as is Thread Sleep functionality.

Definition at line 56 of file mark3cfg.h.

14.100 mark3cfg.h

```
00001 /*===========================================================================
00002     _____          _____          _____          _____
00003  ___|    _|__   __|_    |__   __|__    |__   __| __  |__  _______
00004 |    \  /  | ||    \       ||      |     ||  |/ /     ||___    |
00005 |     \/   | ||     \      ||      \     ||     \     ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||_______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00044 #ifndef __MARK3CFG_H__
00045 #define __MARK3CFG_H__
00046
00056 #define KERNEL_USE_TIMERS               (1)
00057
00067 #if KERNEL_USE_TIMERS
00068     #define KERNEL_USE_QUANTUM          (1)
00069 #else
00070     #define KERNEL_USE_QUANTUM          (0)
00071 #endif
00072
00080 #define KERNEL_USE_SEMAPHORE            (1)
00081
00087 #if KERNEL_USE_SEMAPHORE
00088     #define KERNEL_USE_MESSAGE          (1)
00089 #else
00090     #define KERNEL_USE_MESSAGE          (0)
00091 #endif
00092
00098 #if KERNEL_USE_MESSAGE
00099     #define GLOBAL_MESSAGE_POOL_SIZE    (8)
00100 #endif
00101
00108 #define KERNEL_USE_MUTEX                (1)
00109
```

```
00114 #if KERNEL_USE_TIMERS && KERNEL_USE_SEMAPHORE
00115     #define KERNEL_USE_SLEEP            (1)
00116 #else
00117     #define KERNEL_USE_SLEEP            (0)
00118 #endif
00119
00120
00127 #define KERNEL_USE_DRIVER               (1)
00128
00134 #define KERNEL_USE_THREADNAME           (1)
00135
00142 #define KERNEL_USE_DYNAMIC_THREADS      (1)
00143
00148 #define KERNEL_USE_PROFILER             (1)
00149
00154 #define KERNEL_USE_DEBUG                (0)
00155
00156
00157 #endif
```

14.101 /home/moslevin2/mark3/embedded/stage/src/memutil.cpp File Reference

Implementation of memory, string, and conversion routines.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "kernel_debug.h"
#include "memutil.h"
```

14.101.1 Detailed Description

Implementation of memory, string, and conversion routines.

Definition in file memutil.cpp.

14.102 memutil.cpp

```
00001 /*===========================================================================
00002      _____        _____        _____        _____
00003  ___|    _|__  __|_    |__  __|__   |__  __| __  |__  ______
00004 |    \  /  | ||    \      ||      |     ||  |/ /     ||___   |
00005 |     \/   | ||     \     ||      \     ||     \     ||___   |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00022 #include "kerneltypes.h"
00023 #include "mark3cfg.h"
00024 #include "kernel_debug.h"
00025 #include "memutil.h"
00026
00027 //---------------------------------------------------------------------------
00028 void MemUtil::DecimalToHex( K_UCHAR ucData_, char *szText_ )
00029 {
00030     K_UCHAR ucTmp = ucData_;
00031     K_UCHAR ucMax;
00032
00033     KERNEL_ASSERT( szText_ );
00034
00035     if (ucTmp >= 0x10)
00036     {
00037         ucMax = 2;
00038     }
00039     else
00040     {
00041         ucMax = 1;
00042     }
00043
```

```
00044     ucTmp = ucData_;
00045     szText_[ucMax] = 0;
00046     while (ucMax--)
00047     {
00048         if ((ucTmp & 0x0F) <= 9)
00049         {
00050             szText_[ucMax] = '0' + (ucTmp & 0x0F);
00051         }
00052         else
00053         {
00054             szText_[ucMax] = 'A' + ((ucTmp & 0x0F) - 10);
00055         }
00056         ucTmp>>=4;
00057     }
00058 }
00059
00060 //---------------------------------------------------------------------------
00061 void MemUtil::DecimalToHex( K_USHORT usData_, char *szText_ )
00062 {
00063     K_USHORT usTmp = usData_;
00064     K_USHORT usMax = 1;
00065     K_USHORT usCompare = 0x0010;
00066
00067     KERNEL_ASSERT( szText_ );
00068
00069     while (usData_ > usCompare && usMax < 4)
00070     {
00071         usMax++;
00072         usCompare <<= 4;
00073     }
00074
00075     usTmp = usData_;
00076     szText_[usMax] = 0;
00077     while (usMax--)
00078     {
00079         if ((usTmp & 0x0F) <= 9)
00080         {
00081             szText_[usMax] = '0' + (usTmp & 0x0F);
00082         }
00083         else
00084         {
00085             szText_[usMax] = 'A' + ((usTmp & 0x0F) - 10);
00086         }
00087         usTmp>>=4;
00088     }
00089 }
00090
00091 //---------------------------------------------------------------------------
00092 void MemUtil::DecimalToHex( K_ULONG ulData_, char *szText_ )
00093 {
00094     K_ULONG ulTmp = ulData_;
00095     K_ULONG ulMax = 1;
00096     K_ULONG ulCompare = 0x0010;
00097
00098     KERNEL_ASSERT( szText_ );
00099
00100     while (ulData_ > ulCompare && ulMax < 8)
00101     {
00102         ulMax++;
00103         ulCompare <<= 4;
00104     }
00105
00106     ulTmp = ulData_;
00107     szText_[ulMax] = 0;
00108     while (ulMax--)
00109     {
00110         if ((ulTmp & 0x0F) <= 9)
00111         {
00112             szText_[ulMax] = '0' + (ulTmp & 0x0F);
00113         }
00114         else
00115         {
00116             szText_[ulMax] = 'A' + ((ulTmp & 0x0F) - 10);
00117         }
00118         ulTmp>>=4;
00119     }
00120 }
00121 //---------------------------------------------------------------------------
00122 void MemUtil::DecimalToString( K_UCHAR ucData_, char *szText_ )
00123 {
00124     K_UCHAR ucTmp = ucData_;
00125     K_UCHAR ucMax;
00126
00127     KERNEL_ASSERT(szText_);
00128
00129     // Find max index to print...
00130     if (ucData_ >= 100)
```

```
00131     {
00132         ucMax = 3;
00133     }
00134     else if (ucData_ >= 10)
00135     {
00136         ucMax = 2;
00137     }
00138     else
00139     {
00140         ucMax = 1;
00141     }
00142 
00143     szText_[ucMax] = 0;
00144     while (ucMax--)
00145     {
00146         szText_[ucMax] = '0' + (ucTmp % 10);
00147         ucTmp/=10;
00148     }
00149 }
00150 
00151 //---------------------------------------------------------------------------
00152 void MemUtil::DecimalToString( K_USHORT usData_, char *szText_ )
00153 {
00154     K_USHORT usTmp = usData_;
00155     K_USHORT usMax = 1;
00156     K_USHORT usCompare = 10;
00157 
00158     KERNEL_ASSERT(szText_);
00159 
00160     while (usData_ >= usCompare && usMax < 5)
00161     {
00162         usCompare *= 10;
00163         usMax++;
00164     }
00165 
00166     szText_[usMax] = 0;
00167     while (usMax--)
00168     {
00169         szText_[usMax] = '0' + (usTmp % 10);
00170         usTmp/=10;
00171     }
00172 }
00173 
00174 //---------------------------------------------------------------------------
00175 void MemUtil::DecimalToString( K_ULONG ulData_, char *szText_ )
00176 {
00177     K_ULONG ulTmp = ulData_;
00178     K_ULONG ulMax = 1;
00179     K_ULONG ulCompare = 10;
00180 
00181     KERNEL_ASSERT(szText_);
00182 
00183     while (ulData_ >= ulCompare && ulMax < 12)
00184     {
00185         ulCompare *= 10;
00186         ulMax++;
00187     }
00188 
00189     szText_[ulMax] = 0;
00190     while (ulMax--)
00191     {
00192         szText_[ulMax] = '0' + (ulTmp % 10);
00193         ulTmp/=10;
00194     }
00195 }
00196 
00197 //---------------------------------------------------------------------------
00198 // Basic checksum routines
00199 K_UCHAR  MemUtil::Checksum8( const void *pvSrc_, K_USHORT usLen_ )
00200 {
00201     K_UCHAR ucRet = 0;
00202     K_UCHAR *pcData = (K_UCHAR*)pvSrc_;
00203 
00204     KERNEL_ASSERT(pvSrc_);
00205 
00206     // 8-bit CRC, computed byte at a time
00207     while (usLen_--)
00208     {
00209         ucRet += *pcData++;
00210     }
00211     return ucRet;
00212 }
00213 
00214 //---------------------------------------------------------------------------
00215 K_USHORT MemUtil::Checksum16( const void *pvSrc_, K_USHORT usLen_ )
00216 {
00217     K_USHORT usRet = 0;
```

```
00218     K_UCHAR *pcData = (K_UCHAR*)pvSrc_;
00219
00220     KERNEL_ASSERT(pvSrc_);
00221
00222     // 16-bit CRC, computed byte at a time
00223     while (usLen_--)
00224     {
00225         usRet += *pcData++;
00226     }
00227     return usRet;
00228 }
00229
00230 //---------------------------------------------------------------------------
00231 // Basic string routines
00232 K_USHORT MemUtil::StringLength( const char *szStr_ )
00233 {
00234     K_UCHAR *pcData = (K_UCHAR*)szStr_;
00235     K_USHORT usLen = 0;
00236
00237     KERNEL_ASSERT(szStr_);
00238
00239     while (*pcData++)
00240     {
00241         usLen++;
00242     }
00243     return usLen;
00244 }
00245
00246 //---------------------------------------------------------------------------
00247 bool   MemUtil::CompareStrings( const char *szStr1_, const char *szStr2_ )
00248 {
00249     char *szTmp1 = (char*) szStr1_;
00250     char *szTmp2 = (char*) szStr2_;
00251
00252     KERNEL_ASSERT(szStr1_);
00253     KERNEL_ASSERT(szStr2_);
00254
00255     while (*szTmp1 && *szTmp2)
00256     {
00257         if (*szTmp1++ != *szTmp2++)
00258         {
00259             return false;
00260         }
00261     }
00262
00263     // Both terminate at the same length
00264     if (!(*szTmp1) && !(*szTmp2))
00265     {
00266         return true;
00267     }
00268
00269     return false;
00270 }
00271
00272 //---------------------------------------------------------------------------
00273 void MemUtil::CopyMemory( void *pvDst_, const void *pvSrc_, K_USHORT usLen_ )
00274 {
00275     char *szDst = (char*) pvDst_;
00276     char *szSrc = (char*) pvSrc_;
00277
00278     KERNEL_ASSERT(pvDst_);
00279     KERNEL_ASSERT(pvSrc_);
00280
00281     // Run through the strings verifying that each character matches
00282     // and the lengths are the same.
00283     while (usLen_--)
00284     {
00285         *szDst++ = *szSrc++;
00286     }
00287 }
00288
00289 //---------------------------------------------------------------------------
00290 void MemUtil::CopyString( char *szDst_, const char *szSrc_ )
00291 {
00292     char *szDst = (char*) szDst_;
00293     char *szSrc = (char*) szSrc_;
00294
00295     KERNEL_ASSERT(szDst_);
00296     KERNEL_ASSERT(szSrc_);
00297
00298     // Run through the strings verifying that each character matches
00299     // and the lengths are the same.
00300     while (*szSrc)
00301     {
00302         *szDst++ = *szSrc++;
00303     }
00304 }
```

```
00305
00306 //---------------------------------------------------------------------------
00307 K_SHORT MemUtil::StringSearch( const char *szBuffer_, const char *szPattern_ )
00308 {
00309     char *szTmpPat = (char*)szPattern_;
00310     K_SHORT i16Idx = 0;
00311     K_SHORT i16Start;
00312     KERNEL_ASSERT( szBuffer_ );
00313     KERNEL_ASSERT( szPattern_ );
00314
00315     // Run through the big buffer looking for a match of the pattern
00316     while (szBuffer_[i16Idx])
00317     {
00318         // Reload the pattern
00319         i16Start = i16Idx;
00320         szTmpPat = (char*)szPattern_;
00321         while (*szTmpPat && szBuffer_[i16Idx])
00322         {
00323             if (*szTmpPat != szBuffer_[i16Idx])
00324             {
00325                 break;
00326             }
00327             szTmpPat++;
00328             i16Idx++;
00329         }
00330         // Made it to the end of the pattern, it's a match.
00331         if (*szTmpPat == '\0')
00332         {
00333             return i16Start;
00334         }
00335         i16Idx++;
00336     }
00337
00338     return -1;
00339 }
00340
00341 //---------------------------------------------------------------------------
00342 bool MemUtil::CompareMemory( const void *pvMem1_, const void *pvMem2_, K_USHORT
      usLen_ )
00343 {
00344     char *szTmp1 = (char*) pvMem1_;
00345     char *szTmp2 = (char*) pvMem2_;
00346
00347     KERNEL_ASSERT(pvMem1_);
00348     KERNEL_ASSERT(pvMem2_);
00349
00350     // Run through the strings verifying that each character matches
00351     // and the lengths are the same.
00352     while (usLen_--)
00353     {
00354         if (*szTmp1++ != *szTmp2++)
00355         {
00356             return false;
00357         }
00358     }
00359     return true;
00360 }
00361
00362 //---------------------------------------------------------------------------
00363 void MemUtil::SetMemory( void *pvDst_, K_UCHAR ucVal_, K_USHORT usLen_ )
00364 {
00365     char *szDst = (char*)pvDst_;
00366
00367     KERNEL_ASSERT(pvDst_);
00368
00369     while (usLen_--)
00370     {
00371         *szDst++ = ucVal_;
00372     }
00373 }
00374
00375 //---------------------------------------------------------------------------
00376 K_UCHAR MemUtil::Tokenize( const K_CHAR *szBuffer_, Token_t *pastTokens_, K_UCHAR
      ucMaxTokens_)
00377 {
00378     K_UCHAR ucCurrArg = 0;
00379     K_UCHAR ucLastArg = 0;
00380     K_UCHAR i = 0;
00381
00382     K_UCHAR bEscape = false;
00383
00384     KERNEL_ASSERT(szBuffer_);
00385     KERNEL_ASSERT(pastTokens_);
00386
00387     while (szBuffer_[i])
00388     {
00389         //-- Handle unescaped quotes
```

```
00390         if (szBuffer_[i] == '\"')
00391         {
00392             if (bEscape)
00393             {
00394                 bEscape = false;
00395             }
00396             else
00397             {
00398                 bEscape = true;
00399             }
00400             i++;
00401             continue;
00402         }
00403 
00404         //-- Handle all escaped chars - by ignoring them
00405         if (szBuffer_[i] == '\\')
00406         {
00407             i++;
00408             if (szBuffer_[i])
00409             {
00410                i++;
00411             }
00412             continue;
00413         }
00414 
00415         //-- Process chars based on current escape characters
00416         if (bEscape)
00417         {
00418             // Everything within the quote is treated as literal, but escaped chars are still treated the
    same
00419             i++;
00420             continue;
00421         }
00422 
00423         //-- Non-escaped case
00424         if (szBuffer_[i] != ' ' )
00425         {
00426             i++;
00427             continue;
00428         }
00429 
00430         pastTokens_[ucCurrArg].pcToken = &(szBuffer_[ucLastArg]);
00431         pastTokens_[ucCurrArg].ucLen = i - ucLastArg;
00432         ucCurrArg++;
00433         if (ucCurrArg >= ucMaxTokens_)
00434         {
00435             return ucMaxTokens_;
00436         }
00437 
00438         i++;
00439         while (szBuffer_[i] && szBuffer_[i] == ' ')
00440         {
00441             i++;
00442         }
00443 
00444         ucLastArg = i;
00445     }
00446     if (i && !szBuffer_[i] && (i - ucLastArg))
00447     {
00448         pastTokens_[ucCurrArg].pcToken = &(szBuffer_[ucLastArg]);
00449         pastTokens_[ucCurrArg].ucLen = i - ucLastArg;
00450         ucCurrArg++;
00451     }
00452     return ucCurrArg;
00453 }
00454 
00455 
```

14.103 /home/moslevin2/mark3/embedded/stage/src/memutil.h File Reference

Utility class containing memory, string, and conversion routines.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "kernel_debug.h"
```

Classes

- struct Token_t

  Token descriptor struct format.
- class MemUtil

  String and Memory manipulation class.

14.103.1 Detailed Description

Utility class containing memory, string, and conversion routines.

Definition in file memutil.h.

14.104 memutil.h

```
00001 /*===========================================================================
00002      _____           _____           _____           _____
00003  ___|    _|__   __|_    |__  __|__    |__  __| __   |__  ______
00004 |    \  /  | ||    \       ||     |     ||  |/ /     ||___   |
00005 |     \/   | ||     \      ||     \     ||     \     ||___   |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00021 #ifndef __MEMUTIL_H__
00022 #define __MEMUTIL_H__
00023
00024 #include "kerneltypes.h"
00025 #include "mark3cfg.h"
00026 #include "kernel_debug.h"
00027
00028 //---------------------------------------------------------------------------
00032 typedef struct
00033 {
00034     const K_CHAR *pcToken;
00035     K_UCHAR ucLen;
00036 } Token_t;
00037
00038 //---------------------------------------------------------------------------
00047 class MemUtil
00048 {
00049
00050 public:
00051
00052     //-----------------------------------------------------------------------
00061     static void DecimalToHex( K_UCHAR ucData_, char *szText_ );
00062     static void DecimalToHex( K_USHORT usData_, char *szText_ );
00063     static void DecimalToHex( K_ULONG ulData_, char *szText_ );
00064
00065     //-----------------------------------------------------------------------
00074     static void DecimalToString( K_UCHAR ucData_, char *szText_ );
00075     static void DecimalToString( K_USHORT usData_, char *szText_ );
00076     static void DecimalToString( K_ULONG ulData_, char *szText_ );
00077
00078     //-----------------------------------------------------------------------
00088     static K_UCHAR  Checksum8( const void *pvSrc_, K_USHORT usLen_ );
00089
00090     //-----------------------------------------------------------------------
00100     static K_USHORT Checksum16( const void *pvSrc_, K_USHORT usLen_ );
00101
00102     //-----------------------------------------------------------------------
00112     static K_USHORT StringLength( const char *szStr_ );
00113
00114     //-----------------------------------------------------------------------
00124     static bool CompareStrings( const char *szStr1_, const char *szStr2_ );
00125
00126     //-----------------------------------------------------------------------
00136     static void CopyMemory( void *pvDst_, const void *pvSrc_, K_USHORT usLen_ );
00137
00138     //-----------------------------------------------------------------------
00147     static void CopyString( char *szDst_, const char *szSrc_ );
00148
```

```
00149     //---------------------------------------------------------------------
00159     static K_SHORT StringSearch( const char *szBuffer_, const char *szPattern_ );
00160
00161     //---------------------------------------------------------------------
00173     static bool CompareMemory( const void *pvMem1_, const void *pvMem2_, K_USHORT usLen_ );
00174
00175     //---------------------------------------------------------------------
00185     static void SetMemory( void *pvDst_, K_UCHAR ucVal_, K_USHORT usLen_ );
00186
00187     //---------------------------------------------------------------------
00197     static K_UCHAR Tokenize( const char *szBuffer_, Token_t *pastTokens_, K_UCHAR
      ucMaxTokens_);
00198 };
00199
00200
00201 #endif //__MEMUTIL_H__
00202
00203
00204
00205
```

14.105 /home/moslevin2/mark3/embedded/stage/src/message.cpp File Reference

Inter-thread communications via message passing.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "message.h"
#include "threadport.h"
#include "kernel_debug.h"
#include "timerlist.h"
```

Macros

- #define **__FILE_ID__** MESSAGE_CPP

14.105.1 Detailed Description

Inter-thread communications via message passing.

Definition in file message.cpp.

14.106 message.cpp

```
00001 /*===========================================================================
00002      _____          _____          _____          _____
00003  ___|    _|__   ___|_    |__   ___|__   |__   ___| __  |__   ______
00004 |    \  /   | ||    \       ||       |     ||   |/ /     ||___    |
00005 |     \/    | ||     \      ||       \     ||      \     ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]-----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00022 #include "kerneltypes.h"
00023 #include "mark3cfg.h"
00024
00025 #include "message.h"
00026 #include "threadport.h"
00027 #include "kernel_debug.h"
00028
00029 //---------------------------------------------------------------------------
00030 #if defined __FILE_ID__
00031     #undef __FILE_ID__
```

```
00032 #endif
00033 #define __FILE_ID__     MESSAGE_CPP
00034
00035
00036 #if KERNEL_USE_MESSAGE
00037
00038 #if KERNEL_USE_TIMERS
00039     #include "timerlist.h"
00040 #endif
00041
00042 Message GlobalMessagePool::m_aclMessagePool[8];
00043 DoubleLinkList GlobalMessagePool::m_clList;
00044
00045 //---------------------------------------------------------------------------
00046 void GlobalMessagePool::Init()
00047 {
00048     K_UCHAR i;
00049     for (i = 0; i < GLOBAL_MESSAGE_POOL_SIZE; i++)
00050     {
00051         GlobalMessagePool::m_aclMessagePool[i].
      Init();
00052         GlobalMessagePool::m_clList.Add(&(GlobalMessagePool::m_aclMessagePool
      [i]));
00053     }
00054 }
00055
00056 //---------------------------------------------------------------------------
00057 void GlobalMessagePool::Push( Message *pclMessage_ )
00058 {
00059     KERNEL_ASSERT( pclMessage_ );
00060
00061     CS_ENTER();
00062
00063     GlobalMessagePool::m_clList.Add(pclMessage_);
00064
00065     CS_EXIT();
00066 }
00067
00068 //---------------------------------------------------------------------------
00069 Message *GlobalMessagePool::Pop()
00070 {
00071     Message *pclRet;
00072     CS_ENTER();
00073
00074     pclRet = static_cast<Message*>( GlobalMessagePool::m_clList.GetHead() );
00075     if (0 != pclRet)
00076     {
00077         GlobalMessagePool::m_clList.Remove( static_cast<LinkListNode*>( pclRet ) );
00078     }
00079
00080     CS_EXIT();
00081     return pclRet;
00082 }
00083
00084 //---------------------------------------------------------------------------
00085 void MessageQueue::Init()
00086 {
00087     m_clSemaphore.Init(0, GLOBAL_MESSAGE_POOL_SIZE);
00088 }
00089
00090 //---------------------------------------------------------------------------
00091 Message *MessageQueue::Receive()
00092 {
00093     Message *pclRet;
00094
00095     // Block the current thread on the counting semaphore
00096     m_clSemaphore.Pend();
00097
00098     CS_ENTER();
00099
00100     // Pop the head of the message queue and return it
00101     pclRet = static_cast<Message*>( m_clLinkList.GetHead() );
00102     m_clLinkList.Remove(static_cast<Message*>(pclRet));
00103
00104     CS_EXIT();
00105
00106     return pclRet;
00107 }
00108
00109 #if KERNEL_USE_TIMERS
00110 //---------------------------------------------------------------------------
00111 Message *MessageQueue::Receive( K_ULONG ulTimeWaitMS_ )
00112 {
00113     Message *pclRet;
00114
00115     // Block the current thread on the counting semaphore
00116     if (!m_clSemaphore.Pend(ulTimeWaitMS_))
```

```
00117     {
00118         return NULL;
00119     }
00120 
00121     CS_ENTER();
00122 
00123     // Pop the head of the message queue and return it
00124     pclRet = static_cast<Message*>( m_clLinkList.GetHead() );
00125     m_clLinkList.Remove(static_cast<Message*>(pclRet));
00126 
00127     CS_EXIT();
00128 
00129     return pclRet;
00130 }
00131 #endif
00132 //---------------------------------------------------------------------------
00133 void MessageQueue::Send( Message *pclSrc_ )
00134 {
00135     KERNEL_ASSERT( pclSrc_ );
00136 
00137     CS_ENTER();
00138 
00139     // Add the message to the head of the linked list
00140     m_clLinkList.Add( pclSrc_ );
00141 
00142     // Post the semaphore, waking the blocking thread for the queue.
00143     m_clSemaphore.Post();
00144 
00145     CS_EXIT();
00146 }
00147 
00148 //---------------------------------------------------------------------------
00149 K_USHORT MessageQueue::GetCount()
00150 {
00151     return m_clSemaphore.GetCount();
00152 }
00153 #endif //KERNEL_USE_MESSAGE
```

14.107 /home/moslevin2/mark3/embedded/stage/src/message.h File Reference

Inter-thread communication via message-passing.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "ll.h"
#include "ksemaphore.h"
#include "timerlist.h"
```

Classes

- class Message

  Class to provide message-based IPC services in the kernel.
- class GlobalMessagePool

  Implements a list of message objects shared between all threads.
- class MessageQueue

  List of messages, used as the channel for sending and receiving messages between threads.

14.107.1 Detailed Description

Inter-thread communication via message-passing. Embedded systems guru Jack Ganssle once said that without a robust form of interprocess communications (IPC), an RTOS is just a toy. Mark3 implements a form of IPC to provide safe and flexible messaging between threads.

Using kernel-managed IPC offers significant benefits over other forms of data sharing (i.e. Global variables) in that it avoids synchronization issues and race conditions common to the practice. Using IPC also enforces a more disciplined coding style that keeps threads decoupled from one another and minimizes global data preventing careless and hard-to-debug errors.

14.107.2 Using Messages, Queues, and the Global Message Pool

```
// Declare a message queue shared between two threads
MessageQueue my_queue;

int main()
{
    ...
    // Initialize the message queue
    my_queue.init();
    ...
}

void Thread1()
{
    // Example TX thread - sends a message every 10ms
    while(1)
    {
        // Grab a message from the global message pool
        Message *tx_message = GlobalMessagePool::Pop();

        // Set the message data/parameters
        tx_message->SetCode( 1234 );
        tx_message->SetData( NULL );

        // Send the message on the queue.
        my_queue.Send( tx_message );
        Thread::Sleep(10);
    }
}

void Thread2()
{
    while()
    {
        // Blocking receive - wait until we have messages to process
        Message *rx_message = my_queue.Recv();

        // Do something with the message data...

        // Return back into the pool when done
        GlobalMessagePool::Push(rx_message);
    }
}
```

Definition in file message.h.

14.108 message.h

```
00001 /*=========================================================================
00002      _____          _____          _____          _____
00003  ___|    _|__   __|_    |__   __|__    |__   __| __   |__   ______
00004 |    \  /   | ||    \       ||      |     ||  |/ /     ||___    |
00005 |     \/    | ||     \      ||      \     ||     \     ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 =========================================================================*/
00080 #ifndef __MESSAGE_H__
00081 #define __MESSAGE_H__
00082
00083 #include "kerneltypes.h"
00084 #include "mark3cfg.h"
00085
00086 #include "ll.h"
00087 #include "ksemaphore.h"
00088
00089 #if KERNEL_USE_MESSAGE
00090
00091 #if KERNEL_USE_TIMERS
00092     #include "timerlist.h"
00093 #endif
00094
00095 //---------------------------------------------------------------------------
00099 class Message : public LinkListNode
00100 {
00101 public:
```

```
00107     void Init() { m_pvData = NULL; m_usCode = 0; }
00108
00116     void SetData( void *pvData_ ) { m_pvData = pvData_; }
00117
00125     void *GetData() { return m_pvData; }
00126
00134     void SetCode( K_USHORT usCode_ ) { m_usCode = usCode_; }
00135
00143     K_USHORT GetCode() { return m_usCode; }
00144 private:
00145
00147     void *m_pvData;
00148
00150     K_USHORT m_usCode;
00151 };
00152
00153 //---------------------------------------------------------------------------
00157 class GlobalMessagePool
00158 {
00159 public:
00165     static void Init();
00166
00176     static void Push( Message *pclMessage_ );
00177
00186     static Message *Pop();
00187
00188 private:
00190     static Message m_aclMessagePool[
      GLOBAL_MESSAGE_POOL_SIZE];
00191
00193     static DoubleLinkList m_clList;
00194 };
00195
00196 //---------------------------------------------------------------------------
00201 class MessageQueue
00202 {
00203 public:
00209     void Init();
00210
00219     Message *Receive();
00220
00221 #if KERNEL_USE_TIMERS
00222
00236     Message *Receive( K_ULONG ulTimeWaitMS_ );
00237 #endif
00238
00247     void Send( Message *pclSrc_ );
00248
00249
00257     K_USHORT GetCount();
00258 private:
00259
00261     Semaphore m_clSemaphore;
00262
00264     DoubleLinkList m_clLinkList;
00265 };
00266
00267 #endif //KERNEL_USE_MESSAGE
00268
00269 #endif
```

14.109 /home/moslevin2/mark3/embedded/stage/src/mutex.cpp File Reference

Mutual-exclusion object.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "blocking.h"
#include "mutex.h"
#include "kernel_debug.h"
```

Macros

- #define **__FILE_ID__** MUTEX_CPP

Functions

- void **TimedMutex_Calback** (Thread ∗pclOwner_, void ∗pvData_)

14.109.1 Detailed Description

Mutual-exclusion object.

Definition in file mutex.cpp.

14.110 mutex.cpp

```
/*===========================================================================
     _____        _____        _____        _____
 ___|    _|__  __|_    |__  __|__   |__  __| __  |__  ______
|    \  /  | ||    \      ||     |     ||  |/ /     ||___   |
|     \/   | ||     \     ||     \     ||  \      ||___   |
|__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
    |_____|      |_____|      |_____|      |_____|

--[Mark3 Realtime Platform]--------------------------------------------------

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===========================================================================*/
#include "kerneltypes.h"
#include "mark3cfg.h"

#include "blocking.h"
#include "mutex.h"
#include "kernel_debug.h"
//---------------------------------------------------------------------------
#if defined __FILE_ID__
    #undef __FILE_ID__
#endif
#define __FILE_ID__     MUTEX_CPP


#if KERNEL_USE_MUTEX

#if KERNEL_USE_TIMERS

//---------------------------------------------------------------------------
void TimedMutex_Calback(Thread *pclOwner_, void *pvData_)
{
    Mutex *pclMutex = static_cast<Mutex*>(pvData_);

    // Indicate that the semaphore has expired on the thread
    pclMutex->SetExpired(true);

    // Wake up the thread that was blocked on this semaphore.
    pclMutex->WakeMe(pclOwner_);

    if (pclOwner_->GetPriority() > Scheduler::GetCurrentThread()->
GetPriority())
    {
        Thread::Yield();
    }
}

//---------------------------------------------------------------------------
void Mutex::WakeMe(Thread *pclOwner_)
{
    // Remove from the semaphore waitlist and back to its ready list.
    UnBlock(pclOwner_);
}

#endif

//---------------------------------------------------------------------------
K_UCHAR Mutex::WakeNext()
{
    Thread *pclChosenOne = NULL;

    // Get the highest priority waiter thread
    pclChosenOne = m_clBlockList.HighestWaiter();

    // Unblock the thread
    UnBlock(pclChosenOne);
```

```
00073
00074     // The chosen one now owns the mutex
00075     m_pclOwner = pclChosenOne;
00076
00077     // Signal a context switch if it's a greater than or equal to the current priority
00078     if (pclChosenOne->GetPriority() >= Scheduler::GetCurrentThread()
      ->GetPriority())
00079     {
00080         return 1;
00081     }
00082     return 0;
00083 }
00084
00085 //---------------------------------------------------------------------------
00086 void Mutex::Init()
00087 {
00088     // Reset the data in the mutex
00089     m_bReady = 1;             // The mutex is free.
00090     m_ucMaxPri = 0;           // Set the maximum priority inheritence state
00091     m_pclOwner = NULL;        // Clear the mutex owner
00092 }
00093
00094 //---------------------------------------------------------------------------
00095 #if KERNEL_USE_TIMERS
00096     void Mutex::Claim()
00097     {
00098         Claim(0);
00099     }
00100     bool Mutex::Claim(K_ULONG ulWaitTimeMS_)
00101 #else
00102     void Mutex::Claim()
00103 #endif
00104 {
00105     KERNEL_TRACE_1( STR_MUTEX_CLAIM_1, (K_USHORT)g_pstCurrent->GetID() );
00106
00107     K_UCHAR bSchedule = 0;
00108     Thread *pclThread;
00109
00110 #if KERNEL_USE_TIMERS
00111     Timer clTimer;
00112
00113     m_bExpired = false;
00114 #endif
00115
00116     // Disable the scheduler while claiming the mutex - we're dealing with all
00117     // sorts of private thread data, can't have a thread switch while messing
00118     // with internal data structures.
00119     Scheduler::SetScheduler(0);
00120
00121     // Get the current thread pointer
00122     pclThread = Scheduler::GetCurrentThread();
00123
00124     // Check to see if the mutex is claimed or not
00125     if (m_bReady != 0)
00126     {
00127         // Mutex isn't claimed, claim it.
00128         m_bReady = 0;
00129         m_ucMaxPri = pclThread->GetPriority();
00130         m_pclOwner = pclThread;
00131     }
00132     else
00133     {
00134         // The mutex is claimed already - we have to block now.  Move the
00135         // current thread to the list of threads waiting on the mutex.
00136 #if KERNEL_USE_TIMERS
00137         if (ulWaitTimeMS_)
00138         {
00139             clTimer.Start(0, ulWaitTimeMS_, (TimerCallback_t)TimedMutex_Calback, (void*)this);
00140         }
00141 #endif
00142
00143         Block(pclThread);
00144
00145         // Check if priority inheritence is necessary.  We do this in order
00146         // to ensure that we don't end up with priority inversions in case
00147         // multiple threads are waiting on the same resource.
00148         if(m_ucMaxPri <= pclThread->GetPriority())
00149         {
00150             m_ucMaxPri = pclThread->GetPriority();
00151
00152             {
00153                 Thread *pclTemp = static_cast<Thread*>(m_clBlockList.GetHead());
00154                 while(pclTemp)
00155                 {
00156                     pclTemp->InheritPriority(m_ucMaxPri);
00157                     if(pclTemp == static_cast<Thread*>(m_clBlockList.GetTail()) )
00158                     {
```

```
00159                       break;
00160                   }
00161                   pclTemp = static_cast<Thread*>(pclTemp->GetNext());
00162               }
00163               m_pclOwner->InheritPriority(m_ucMaxPri);
00164           }
00165       }
00166
00167       // Switch Threads when we exit the critical section.
00168       bSchedule = 1;
00169   }
00170
00171   // Done with thread data -reenable the scheduler
00172   Scheduler::SetScheduler(1);
00173
00174   if (bSchedule)
00175   {
00176       // Switch threads if this thread acquired the mutex
00177       Thread::Yield();
00178   }
00179
00180 #if KERNEL_USE_TIMERS
00181   if (ulWaitTimeMS_)
00182   {
00183       clTimer.Stop();
00184   }
00185   return (m_bExpired == 0);
00186 #endif
00187 }
00188
00189 //---------------------------------------------------------------------------
00190 void Mutex::Release()
00191 {
00192   KERNEL_TRACE_1( STR_MUTEX_RELEASE_1, (K_USHORT)g_pstCurrent->GetID() );
00193
00194   K_UCHAR bSchedule = 0;
00195   Thread *pclThread;
00196
00197   // Disable the scheduler while we deal with internal data structures.
00198   Scheduler::SetScheduler(0);
00199   pclThread = Scheduler::GetCurrentThread();
00200
00201   // Restore the thread's original priority
00202   if (pclThread->GetCurPriority() != pclThread->GetPriority())
00203   {
00204       pclThread->SetPriority(pclThread->GetPriority());
00205
00206       // In this case, we want to reschedule
00207       bSchedule = 1;
00208   }
00209
00210   // No threads are waiting on this semaphore?
00211   if (m_clBlockList.GetHead() == NULL)
00212   {
00213       // Re-initialize the mutex to its default values
00214       m_bReady = 1;
00215       m_ucMaxPri = 0;
00216       m_pclOwner = NULL;
00217   }
00218   else
00219   {
00220       // Wake the highest priority Thread pending on the mutex
00221       if(WakeNext())
00222       {
00223           // Switch threads if it's higher or equal priority than the current thread
00224           bSchedule = 1;
00225       }
00226   }
00227
00228   // Must enable the scheduler again in order to switch threads.
00229   Scheduler::SetScheduler(1);
00230   if(bSchedule)
00231   {
00232       // Switch threads if a higher-priority thread was woken
00233       Thread::Yield();
00234   }
00235 }
00236
00237 #endif //KERNEL_USE_MUTEX
```

14.111 /home/moslevin2/mark3/embedded/stage/src/mutex.h File Reference

Mutual exclusion class declaration.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "blocking.h"
#include "timerlist.h"
```

Classes

- class Mutex

  Mutual-exclusion locks, based on BlockingObject.

14.111.1 Detailed Description

Mutual exclusion class declaration. Resource locks are implemented using mutual exclusion semaphores (Mutex_t). Protected blocks can be placed around any resource that may only be accessed by one thread at a time. If additional threads attempt to access the protected resource, they will be placed in a wait queue until the resource becomes available. When the resource becomes available, the thread with the highest original priority claims the resource and is activated. Priority inheritance is included in the implementation to prevent priority inversion. Always ensure that you claim and release your mutex objects consistently, otherwise you may end up with a deadlock scenario that's hard to debug.

14.111.2 Initializing

Initializing a mutex object by calling:

```
clMutex.Init();
```

14.111.3 Resource protection example

```
clMutex.Claim();
...
<resource protected block>
...
clMutex.Release();
```

Definition in file mutex.h.

14.112 mutex.h

```
00001 /*===========================================================================
00002      _____        _____        _____        _____
00003  ___|    _|__  __|_    |__  __|__   |__  __| __  |__  ______
00004 |    \  /   | ||    \      ||      |     ||  |/ /     ||___   |
00005 |     \/    | ||     \     ||      \     ||     \     ||___   |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00050 #ifndef __MUTEX_H_
00051 #define __MUTEX_H_
00052
00053 #include "kerneltypes.h"
00054 #include "mark3cfg.h"
00055
00056 #include "blocking.h"
00057
00058 #if KERNEL_USE_MUTEX
00059
```

```
00060 #if KERNEL_USE_TIMERS
00061 #include "timerlist.h"
00062 #endif
00063
00064 //---------------------------------------------------------------------------
00068 class Mutex : public BlockingObject
00069 {
00070 public:
00077     void Init();
00078
00085     void Claim();
00086
00087 #if KERNEL_USE_TIMERS
00088
00097     bool Claim(K_ULONG ulWaitTimeMS_);
00098
00111     void WakeMe( Thread *pclOwner_ );
00112
00118     void SetExpired( bool bExpired_ ) { m_bExpired = bExpired_; }
00119 #endif
00120
00127     void Release();
00128
00129 private:
00130
00136     K_UCHAR WakeNext();
00137
00138     K_UCHAR m_bReady;
00139     K_UCHAR m_ucMaxPri;
00140     Thread *m_pclOwner;
00141
00142 #if KERNEL_USE_TIMERS
00143     bool    m_bExpired;
00144 #endif
00145 };
00146
00147 #endif //KERNEL_USE_MUTEX
00148
00149 #endif //__MUTEX_H_
00150
```

14.113 /home/moslevin2/mark3/embedded/stage/src/nlfs.cpp File Reference

Nice Little Filesystem (NLFS) implementation for Mark3.

```
#include "kerneltypes.h"
#include "nlfs.h"
#include "nlfs_file.h"
#include "memutil.h"
#include "nlfs_config.h"
```

14.113.1 Detailed Description

Nice Little Filesystem (NLFS) implementation for Mark3.

Definition in file nlfs.cpp.

14.114 nlfs.cpp

```
00001 /*===========================================================================
00002      _____        _____        _____        _____
00003  ___|     |__  __|_    |__  __|__   |__  __|  __  |__  ______
00004 |    \   /  | ||    \      ||      |     ||  |/ /     ||___   |
00005 |     \/    | ||     \     ||      \     ||     \     ||___   |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]-----------------------------------------------
00010
00011 Copyright (c) 2013 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
```

```
00013 ===========================================================================*/
00019 #include "kerneltypes.h"
00020 #include "nlfs.h"
00021 #include "nlfs_file.h"
00022 #include "memutil.h"
00023 #include "nlfs_config.h"
00024
00025 //---------------------------------------------------------------------------
00026 K_CHAR NLFS::Find_Last_Slash( const char *szPath_ )
00027 {
00028     K_UCHAR ucLastSlash = 0;
00029     K_UCHAR i = 0;
00030     while (szPath_[i])
00031     {
00032         if (szPath_[i] == '/')
00033         {
00034             ucLastSlash = i;
00035         }
00036         i++;
00037     }
00038     return ucLastSlash;
00039 }
00040
00041 //---------------------------------------------------------------------------
00042 K_BOOL NLFS::File_Names_Match( const K_CHAR *szPath_,
    NLFS_Node_t *pstNode_)
00043 {
00044     K_UCHAR ucLastSlash = Find_Last_Slash( szPath_ );
00045     K_UCHAR i;
00046
00047     ucLastSlash++;
00048     for (i = 0; i < FILE_NAME_LENGTH; i++)
00049     {
00050         if (!szPath_[ucLastSlash+i] || !pstNode_->stFileNode.
    acFileName[i])
00051         {
00052             break;
00053         }
00054         if (szPath_[ucLastSlash+i] != pstNode_->stFileNode.acFileName[i])
00055         {
00056             return false;
00057         }
00058     }
00059
00060     if (szPath_[ucLastSlash+i] != pstNode_->stFileNode.acFileName[i])
00061     {
00062         return false;
00063     }
00064     return true;
00065 }
00066
00067 //---------------------------------------------------------------------------
00068 void NLFS::Print_File_Details( K_USHORT usNode_ )
00069 {
00070     NLFS_Node_t stFileNode;
00071     Read_Node(usNode_, &stFileNode);
00072
00073     DEBUG_PRINT(" Name       : %16s\n" , stFileNode.stFileNode.
    acFileName);
00074     DEBUG_PRINT(" Next Peer  : %d\n"   , stFileNode.stFileNode.
    usNextPeer);
00075     DEBUG_PRINT(" Prev Peer  : %d\n"   , stFileNode.stFileNode.
    usPrevPeer);
00076     DEBUG_PRINT(" User|Group : %d|%d\n", stFileNode.stFileNode.ucUser,
00077                                          stFileNode.stFileNode.ucGroup);
00078
00079     DEBUG_PRINT(" Permissions: %04X\n" , stFileNode.stFileNode.usPerms);
00080     DEBUG_PRINT(" Parent     : %d\n"   , stFileNode.stFileNode.
    usParent);
00081     DEBUG_PRINT(" First Child: %d\n"   , stFileNode.stFileNode.usChild);
00082     DEBUG_PRINT(" Alloc Size : %d\n"   , stFileNode.stFileNode.
    ulAllocSize);
00083     DEBUG_PRINT(" File  Size : %d\n"   , stFileNode.stFileNode.
    ulFileSize);
00084
00085     DEBUG_PRINT(" First Block: %d\n"   , stFileNode.stFileNode.
    ulFirstBlock);
00086     DEBUG_PRINT(" Last Block : %d\n"   , stFileNode.stFileNode.
    ulLastBlock);
00087 }
00088
00089 //---------------------------------------------------------------------------
00090 void NLFS::Print_Dir_Details( K_USHORT usNode_ )
00091 {
00092     NLFS_Node_t stFileNode;
00093     Read_Node(usNode_, &stFileNode);
00094
```

```
00095     DEBUG_PRINT(" Name       : %16s\n" , stFileNode.stFileNode.
      acFileName);
00096     DEBUG_PRINT(" Next Peer  : %d\n"   , stFileNode.stFileNode.
      usNextPeer);
00097     DEBUG_PRINT(" Prev Peer  : %d\n"   , stFileNode.stFileNode.
      usPrevPeer);
00098     DEBUG_PRINT(" User|Group : %d|%d\n", stFileNode.stFileNode.ucUser,
00099                                         stFileNode.stFileNode.ucGroup);
00100     DEBUG_PRINT(" Permissions: %04X\n"  , stFileNode.stFileNode.
      usPerms);
00101     DEBUG_PRINT(" Parent     : %d\n"   , stFileNode.stFileNode.
      usParent);
00102     DEBUG_PRINT(" First Child: %d\n"   , stFileNode.stFileNode.usChild);
00103 }
00104
00105 //---------------------------------------------------------------------------
00106 void NLFS::Print_Free_Details( K_USHORT usNode_ )
00107 {
00108     NLFS_Node_t stFileNode;
00109     Read_Node(usNode_, &stFileNode);
00110
00111     DEBUG_PRINT(" Next Free  : %d\n"    , stFileNode.stFileNode.
      usNextPeer );
00112 }
00113
00114 //---------------------------------------------------------------------------
00115 void NLFS::Print_Node_Details( K_USHORT usNode_ )
00116 {
00117     NLFS_Node_t stTempNode;
00118     Read_Node(usNode_, &stTempNode);
00119
00120     DEBUG_PRINT("\nNode: %d\n"
00121            " Node Type: ", usNode_);
00122     switch (stTempNode.eBlockType)
00123     {
00124         case NLFS_NODE_FREE:
00125             DEBUG_PRINT( "Free\n" );
00126             Print_Free_Details(usNode_);
00127             break;
00128         case NLFS_NODE_ROOT:
00129             DEBUG_PRINT( "Root Block\n" );
00130             break;
00131         case NLFS_NODE_FILE:
00132             DEBUG_PRINT( "File\n" );
00133             Print_File_Details(usNode_);
00134             break;
00135         case NLFS_NODE_DIR:
00136             DEBUG_PRINT( "Directory\n" );
00137             Print_Dir_Details(usNode_);
00138             break;
00139         default:
00140             break;
00141     }
00142 }
00143
00144 //---------------------------------------------------------------------------
00145 K_USHORT NLFS::Pop_Free_Node(void)
00146 {
00147     K_USHORT usRetVal = m_stLocalRoot.usNextFreeNode;
00148     NLFS_Node_t stFileNode;
00149
00150     if (INVALID_NODE == usRetVal)
00151     {
00152         return 0;
00153     }
00154
00155     // Update Claimed node
00156     Read_Node(usRetVal, &stFileNode);
00157     m_stLocalRoot.usNextFreeNode = stFileNode.
      stFileNode.usNextPeer;
00158     stFileNode.stFileNode.usNextPeer = INVALID_NODE;
00159     DEBUG_PRINT("Node %d allocated, next free %d\n", usRetVal, m_stLocalRoot.
      usNextFreeNode);
00160     Write_Node(usRetVal, &stFileNode);
00161
00162     //Update root node
00163     Read_Node(FS_CONFIG_BLOCK , &stFileNode);
00164     stFileNode.stRootNode.usNextFreeNode = m_stLocalRoot.
      usNextFreeNode;
00165     stFileNode.stRootNode.usNumFilesFree--;
00166     Write_Node(FS_CONFIG_BLOCK, &stFileNode);
00167
00168     return usRetVal;
00169 }
00170
00171 //---------------------------------------------------------------------------
00172 void NLFS::Push_Free_Node(K_USHORT usNode_)
```

```
00173 {
00174     NLFS_Node_t stFileNode;
00175 
00176     Read_Node(usNode_, &stFileNode);
00177     stFileNode.stFileNode.usNextPeer = m_stLocalRoot.
      usNextFreeNode;
00178     m_stLocalRoot.usNextFreeNode = usNode_;
00179 
00180     Write_Node(usNode_, &stFileNode);
00181 
00182     DEBUG_PRINT("Node %d freed\n", usNode_);
00183 
00184     //Update root node
00185     Read_Node(FS_CONFIG_BLOCK , &stFileNode);
00186     stFileNode.stRootNode.usNextFreeNode = m_stLocalRoot.
      usNextFreeNode;
00187     stFileNode.stRootNode.usNumFilesFree++;
00188     Write_Node(FS_CONFIG_BLOCK , &stFileNode);
00189 }
00190 
00191 //---------------------------------------------------------------------------
00192 K_ULONG NLFS::Pop_Free_Block(void)
00193 {
00194     K_ULONG ulRetVal = m_stLocalRoot.ulNextFreeBlock;
00195     NLFS_Block_t stFileBlock;
00196     NLFS_Node_t  stFileNode;
00197 
00198     if ((INVALID_BLOCK == ulRetVal) || (0 == m_stLocalRoot.
      ulNumBlocksFree))
00199     {
00200         DEBUG_PRINT("Out of data blocks\n");
00201         return 0;
00202     }
00203 
00204     Read_Block_Header(ulRetVal, &stFileBlock);
00205 
00206     m_stLocalRoot.ulNextFreeBlock = stFileBlock.
      ulNextBlock;
00207     m_stLocalRoot.ulNumBlocksFree--;
00208     stFileBlock.ulNextBlock = INVALID_BLOCK;
00209 
00210     Write_Block_Header(ulRetVal, &stFileBlock);
00211 
00212     Read_Node(FS_CONFIG_BLOCK , &stFileNode);
00213 
00214     stFileNode.stRootNode.ulNextFreeBlock =
      m_stLocalRoot.ulNextFreeBlock;
00215     stFileNode.stRootNode.ulNumBlocksFree--;
00216 
00217     Write_Node(FS_CONFIG_BLOCK , &stFileNode);
00218 
00219     DEBUG_PRINT("Allocated block %d, next free %d\n", ulRetVal, m_stLocalRoot.
      ulNextFreeBlock);
00220     return ulRetVal;
00221 }
00222 
00223 //---------------------------------------------------------------------------
00224 void NLFS::Push_Free_Block(K_ULONG ulBlock_ )
00225 {
00226     NLFS_Block_t stFileBlock;
00227     NLFS_Node_t  stFileNode;
00228 
00229     Read_Block_Header(ulBlock_, &stFileBlock);
00230 
00231     stFileBlock.ulNextBlock = m_stLocalRoot.
      ulNextFreeBlock;
00232     m_stLocalRoot.ulNextFreeBlock = ulBlock_;
00233 
00234     Write_Block_Header(ulBlock_, &stFileBlock);
00235 
00236     Read_Node(FS_CONFIG_BLOCK , &stFileNode);
00237     stFileNode.stRootNode.ulNextFreeBlock =
      m_stLocalRoot.ulNextFreeBlock;
00238     stFileNode.stRootNode.ulNumBlocksFree++;
00239     Write_Node(FS_CONFIG_BLOCK , &stFileNode);
00240 
00241     DEBUG_PRINT("Block %d freed\n", ulBlock_);
00242 }
00243 
00244 //---------------------------------------------------------------------------
00245 K_ULONG NLFS::Append_Block_To_Node(NLFS_Node_t *pstFile_ )
00246 {
00247     K_ULONG ulBlock;
00248     NLFS_Block_t stFileBlock;
00249 
00250     // Allocate a new block
00251     ulBlock = Pop_Free_Block();
```

```
00252     if (ulBlock == INVALID_BLOCK)
00253     {
00254         return -1;
00255     }
00256 
00257     // Initialize the block
00258     DEBUG_PRINT("reading block header\n");
00259     Read_Block_Header(ulBlock, &stFileBlock);
00260     stFileBlock.ulNextBlock = INVALID_BLOCK;
00261     stFileBlock.uAllocated  = 1;
00262 
00263     DEBUG_PRINT("writing block header\n");
00264     Write_Block_Header(ulBlock, &stFileBlock);
00265 
00266     // Update the previous last-block links (if there is one)
00267     DEBUG_PRINT("updating previous block %d\n", pstFile_->stFileNode.
      ulLastBlock);
00268     if (pstFile_->stFileNode.ulLastBlock != INVALID_BLOCK)
00269     {
00270         Read_Block_Header(pstFile_->stFileNode.
      ulLastBlock, &stFileBlock);
00271         stFileBlock.ulNextBlock = ulBlock;
00272         Write_Block_Header(pstFile_->stFileNode.
      ulLastBlock, &stFileBlock);
00273     }
00274     else
00275     {
00276         DEBUG_PRINT("  previous block is invalid, setting as first\n");
00277         pstFile_->stFileNode.ulFirstBlock = ulBlock;
00278     }
00279 
00280     pstFile_->stFileNode.ulLastBlock = ulBlock;
00281     pstFile_->stFileNode.ulAllocSize += m_stLocalRoot.
      ulBlockSize;
00282 
00283     RootSync();
00284 
00285     return ulBlock;
00286 }
00287 
00288 //---------------------------------------------------------------------------
00289 K_USHORT NLFS::Find_Parent_Dir(const K_CHAR *szPath_)
00290 {
00291     int i, j;
00292     K_UCHAR ucLastSlash = 0;
00293     K_USHORT usRetVal;
00294     K_CHAR szTempName[FILE_NAME_LENGTH];
00295     NLFS_Node_t stFileNode;
00296     K_USHORT usTempPeer;
00297 
00298     Read_Node(FS_ROOT_BLOCK, &stFileNode );
00299 
00300     usRetVal = FS_ROOT_BLOCK;
00301 
00302     if (szPath_[0] != '/')
00303     {
00304         DEBUG_PRINT("Only fully-qualified paths are supported.  Bailing\n");
00305         return -1;
00306     }
00307 
00308     // Starting from the root fs_block (which is the mount point...)
00309     ucLastSlash = Find_Last_Slash(szPath_);
00310 
00311     // a) Search for each "/" if we've got more than one...
00312     if (0 == ucLastSlash)
00313     {
00314         return usRetVal;
00315     }
00316 
00317     usTempPeer = stFileNode.stFileNode.usChild;
00318     Read_Node(usTempPeer, &stFileNode );
00319 
00320     i = 1;
00321     while (szPath_[i] && i < ucLastSlash)
00322     {
00323         NLFS_Node_t stTempNode;
00324         K_BOOL bMatch = false;
00325 
00326         j = 0;
00327         MemUtil::SetMemory(szTempName, 0, FILE_NAME_LENGTH);
00328 
00329         while (szPath_[i] && (szPath_[i] != '/') && j < FILE_NAME_LENGTH)
00330         {
00331             szTempName[j] = szPath_[i];
00332             i++;
00333             j++;
00334         }
```

```
00335         DEBUG_PRINT("Checking %s\n", szTempName );
00336         if (j == FILE_NAME_LENGTH && szPath_[i] != '/')
00337         {
00338             DEBUG_PRINT("Directory name too long, invalid\n");
00339             return -1;
00340         }
00341         else if (szPath_[i] != '/')
00342         {
00343             i++;
00344             continue;
00345         }
00346 
00347         // Check to see if there's a valid peer with this name...
00348         while (INVALID_NODE != usTempPeer)
00349         {
00350             Read_Node(usTempPeer, &stTempNode);
00351             if (NLFS_NODE_DIR == stTempNode.eBlockType)
00352             {
00353                 if (true == MemUtil::CompareStrings(stTempNode.
      stFileNode.acFileName, szTempName))
00354                 {
00355                     bMatch = true;
00356                     break;
00357                 }
00358             }
00359             usTempPeer = stTempNode.stFileNode.usNextPeer;
00360         }
00361 
00362         // Matched the folder name descend into the folder
00363         if (bMatch)
00364         {
00365             DEBUG_PRINT("Matched folder: %s, node %d\n", szTempName, usTempPeer);
00366 
00367             usRetVal = usTempPeer;
00368 
00369             usTempPeer = stTempNode.stFileNode.usChild;
00370             if (INVALID_NODE != usTempPeer)
00371             {
00372                 DEBUG_PRINT("Entering subdirectory %d\n", usTempPeer);
00373                 Read_Node(usTempPeer, &stFileNode);
00374             }
00375             else
00376             {
00377                 break;
00378             }
00379         }
00380         // Failed to match the folder name, bail
00381         else
00382         {
00383             DEBUG_PRINT("Could not match folder name, bailing\n");
00384             usRetVal = -1;
00385             break;
00386         }
00387 
00388         if (i >= ucLastSlash)
00389         {
00390             break;
00391         }
00392         i++;
00393     }
00394 
00395     if (i == ucLastSlash)
00396     {
00397         // No more folders to traverse - we're successful.
00398         DEBUG_PRINT("Found root path for %s\n with node %d\n", szPath_, usRetVal);
00399         return usRetVal;
00400     }
00401     return INVALID_NODE;
00402 }
00403 
00404 //---------------------------------------------------------------------------
00405 K_USHORT NLFS::Find_File(const K_CHAR *szPath_)
00406 {
00407     NLFS_Node_t stTempNode;
00408     NLFS_Node_t stTempDir;
00409 
00410     K_USHORT usTempNode;
00411 
00412     K_USHORT usParentDir = Find_Parent_Dir(szPath_);
00413 
00414     if (INVALID_NODE == usParentDir)
00415     {
00416         DEBUG_PRINT("invalid root dir\n");
00417         return INVALID_NODE;
00418     }
00419 
00420     Read_Node(usParentDir, &stTempDir);
```

```
00421
00422     if (INVALID_NODE == stTempDir.stFileNode.usChild)
00423     {
00424         return INVALID_NODE;
00425     }
00426
00427     usTempNode = stTempDir.stFileNode.usChild;
00428
00429     // See if there are matching child nodes
00430     while (INVALID_NODE != usTempNode)
00431     {
00432         Read_Node(usTempNode, &stTempNode);
00433
00434         if (true == File_Names_Match(szPath_,&stTempNode ))
00435         {
00436             DEBUG_PRINT("matched file: %16s, node %d\n",
00437                    stTempNode.stFileNode.acFileName, usTempNode);
00438             return usTempNode;
00439         }
00440
00441         usTempNode = stTempNode.stFileNode.usNextPeer;
00442     }
00443     DEBUG_PRINT("couldn't match file: %s\n", szPath_);
00444     return INVALID_NODE;
00445 }
00446
00447 //---------------------------------------------------------------------------
00448 void NLFS::Print(void)
00449 {
00450     K_USHORT i;
00451     for (i = 0; i < m_stLocalRoot.usNumFiles; i++)
00452     {
00453         Print_Node_Details(i);
00454     }
00455 }
00456
00457 //---------------------------------------------------------------------------
00458 void NLFS::Set_Node_Name( NLFS_Node_t *pstFileNode_, const char *szPath_ )
00459 {
00460     K_UCHAR i,j;
00461     K_UCHAR ucLastSlash = 0;
00462
00463     // Search for the last "/", that's where we stop looking.
00464     i = 0;
00465     while (szPath_[i])
00466     {
00467         if (szPath_[i] == '/')
00468         {
00469             ucLastSlash = i;
00470         }
00471         i++;
00472     }
00473
00474     // Parse out filename
00475     i = ucLastSlash + 1;
00476     j = 0;
00477     while (szPath_[i] && j < FILE_NAME_LENGTH)
00478     {
00479         pstFileNode_->stFileNode.acFileName[j] = szPath_[i];
00480         j++;
00481         i++;
00482     }
00483     if (!szPath_[i]) // if no extension, we're done.
00484     {
00485         return;
00486     }
00487 }
00488
00489 //---------------------------------------------------------------------------
00490 K_USHORT NLFS::Create_File_i(const K_CHAR *szPath_,
      NLFS_Type_t eType_ )
00491 {
00492     K_USHORT usNode;
00493     K_USHORT usRootNodes;
00494
00495     NLFS_Node_t stFileNode;
00496     NLFS_Node_t stParentNode;
00497     NLFS_Node_t stPeerNode;
00498
00499     // Tricky part - directory traversal
00500     usRootNodes = Find_Parent_Dir(szPath_);
00501
00502     if (INVALID_NODE == usRootNodes)
00503     {
00504         DEBUG_PRINT("Unable to find path - bailing\n");
00505         return INVALID_NODE;
00506     }
```

```
00507
00508     usNode = Pop_Free_Node();
00509     if (!usNode)
00510     {
00511         DEBUG_PRINT("Unable to allocate node.  Failing\n");
00512         return INVALID_NODE;
00513     }
00514     DEBUG_PRINT("New file using node %d\n", usNode);
00515
00516     // File node allocated, do something with it...
00517     // Set the file's name and extension
00518
00519     Read_Node(usNode, &stFileNode);
00520
00521     // Set the file path
00522     Set_Node_Name(&stFileNode, szPath_);
00523
00524     // Set block as in-use as a file
00525     stFileNode.eBlockType = eType_;
00526
00527     // Zero-out the file
00528     stFileNode.stFileNode.ulFileSize = 0;
00529
00530     // Set the default user and group, as well as perms
00531     stFileNode.stFileNode.ucUser   = 0;
00532     stFileNode.stFileNode.ucGroup  = 0;
00533     stFileNode.stFileNode.usPerms  = PERM_U_ALL | PERM_G_ALL | PERM_O_ALL;
00534
00535     stFileNode.stFileNode.usChild  = INVALID_NODE;
00536     stFileNode.stFileNode.usParent = usRootNodes;
00537
00538     // Update the parent node.
00539     Read_Node(usRootNodes, &stParentNode);
00540
00541     DEBUG_PRINT( "Parent's root child: %d\n", stParentNode.stFileNode.
    usChild );
00542     // Insert node at the beginning of the peer list
00543     if (INVALID_NODE != stParentNode.stFileNode.usChild)
00544     {
00545         stFileNode.stFileNode.usNextPeer = stParentNode.
    stFileNode.usChild;
00546         stFileNode.stFileNode.usPrevPeer = INVALID_NODE;
00547
00548         // Update the peer node.
00549         Read_Node(stFileNode.stFileNode.usNextPeer , &stPeerNode);
00550
00551         stPeerNode.stFileNode.usPrevPeer = usNode;
00552         stParentNode.stFileNode.usChild = usNode;
00553
00554         DEBUG_PRINT("updating peer's prev: %d\n", stPeerNode.stFileNode.
    usPrevPeer);
00555         Write_Node(stFileNode.stFileNode.usNextPeer, &stPeerNode);
00556     }
00557     else
00558     {
00559         stParentNode.stFileNode.usChild = usNode;
00560         stFileNode.stFileNode.usNextPeer = INVALID_NODE;
00561         stFileNode.stFileNode.usPrevPeer = INVALID_NODE;
00562     }
00563
00564     Write_Node(usNode, &stFileNode);
00565     Write_Node(usRootNodes, &stParentNode);
00566
00567     RootSync();
00568
00569     return usNode;
00570 }
00571
00572 //---------------------------------------------------------------------------
00573 K_USHORT NLFS::Create_File( const K_CHAR *szPath_ )
00574 {
00575
00576     if (INVALID_NODE != Find_File(szPath_))
00577     {
00578         DEBUG_PRINT("Create_File: File already exists\n");
00579         return INVALID_NODE;
00580     }
00581
00582     return Create_File_i( szPath_, NLFS_NODE_FILE );
00583 }
00584
00585 //---------------------------------------------------------------------------
00586 K_USHORT NLFS::Create_Dir( const K_CHAR *szPath_ )
00587 {
00588     if (INVALID_NODE != Find_File(szPath_))
00589     {
00590         DEBUG_PRINT("Create_Dir: Dir already exists!\n");
```

```
00591         return INVALID_NODE;
00592     }
00593
00594     return Create_File_i(szPath_, NLFS_NODE_DIR );
00595 }
00596
00597 //---------------------------------------------------------------------------
00598 void NLFS::Cleanup_Node_Links(K_USHORT usNode_,
      NLFS_Node_t *pstNode_)
00599 {
00600     DEBUG_PRINT("Cleanup_Node_Links: Entering\n");
00601
00602     if (INVALID_NODE != pstNode_->stFileNode.usParent)
00603     {
00604         NLFS_Node_t stParent;
00605         DEBUG_PRINT("Cleanup_Node_Links: Parent Node: %d\n", pstNode_->
      stFileNode.usParent);
00606         Read_Node(pstNode_->stFileNode.usParent, &stParent);
00607
00608         DEBUG_PRINT("0\n");
00609         if (stParent.stFileNode.usChild == usNode_)
00610         {
00611             DEBUG_PRINT("1\n");
00612             stParent.stFileNode.usChild = pstNode_->stFileNode.
      usNextPeer;
00613             Write_Node(pstNode_->stFileNode.usParent, &stParent);
00614             DEBUG_PRINT("2\n");
00615         }
00616     }
00617
00618     DEBUG_PRINT("a\n");
00619     if ( (INVALID_NODE != pstNode_->stFileNode.usNextPeer) ||
00620          (INVALID_NODE != pstNode_->stFileNode.usPrevPeer) )
00621     {
00622         NLFS_Node_t stNextPeer;
00623         NLFS_Node_t stPrevPeer;
00624
00625         DEBUG_PRINT("b\n");
00626         if (INVALID_NODE != pstNode_->stFileNode.usNextPeer)
00627         {
00628             DEBUG_PRINT("c\n");
00629             Read_Node(pstNode_->stFileNode.usNextPeer, &stNextPeer);
00630             DEBUG_PRINT("d\n");
00631         }
00632
00633         if (INVALID_NODE != pstNode_->stFileNode.usPrevPeer)
00634         {
00635             DEBUG_PRINT("e\n");
00636             Read_Node(pstNode_->stFileNode.usPrevPeer, &stPrevPeer);
00637             DEBUG_PRINT("f\n");
00638         }
00639
00640         if (INVALID_NODE != pstNode_->stFileNode.usNextPeer)
00641         {
00642             DEBUG_PRINT("g\n");
00643             stNextPeer.stFileNode.usPrevPeer = pstNode_->
      stFileNode.usPrevPeer;
00644             Write_Node(pstNode_->stFileNode.usNextPeer, &stNextPeer);
00645             DEBUG_PRINT("h\n");
00646         }
00647
00648         if (INVALID_NODE != pstNode_->stFileNode.usPrevPeer)
00649         {
00650             DEBUG_PRINT("i\n");
00651             stPrevPeer.stFileNode.usNextPeer = pstNode_->
      stFileNode.usNextPeer;
00652             Write_Node(pstNode_->stFileNode.usPrevPeer, &stPrevPeer);
00653             DEBUG_PRINT("j\n");
00654         }
00655     }
00656     pstNode_->stFileNode.usParent = INVALID_NODE;
00657     pstNode_->stFileNode.usPrevPeer = INVALID_NODE;
00658     pstNode_->stFileNode.usNextPeer = INVALID_NODE;
00659 }
00660
00661 //---------------------------------------------------------------------------
00662 K_USHORT NLFS::Delete_Folder(const K_CHAR *szPath_)
00663 {
00664     K_USHORT usNode = Find_File(szPath_);
00665     NLFS_Node_t stNode;
00666
00667     if (INVALID_NODE == usNode)
00668     {
00669         DEBUG_PRINT("Delete_Folder: File not found!\n");
00670         return INVALID_NODE;
00671     }
00672     if (FS_ROOT_BLOCK == usNode || FS_CONFIG_BLOCK == usNode)
```

```
00673     {
00674         DEBUG_PRINT("Delete_Folder: Cannot delete root!\n");
00675         return INVALID_NODE;
00676     }
00677 
00678     Read_Node(usNode, &stNode);
00679 
00680     if (NLFS_NODE_FILE == stNode.eBlockType)
00681     {
00682         DEBUG_PRINT("Delete_Folder: Path is not a Folder (is it a file?)");
00683         return INVALID_NODE;
00684     }
00685 
00686     if (INVALID_NODE != stNode.stFileNode.usChild)
00687     {
00688         DEBUG_PRINT("Delete_Folder: Folder is not empty!");
00689         return INVALID_NODE;
00690     }
00691 
00692     Cleanup_Node_Links(usNode, &stNode);
00693 
00694     stNode.eBlockType = NLFS_NODE_FREE;
00695 
00696     Write_Node(usNode, &stNode);
00697     Push_Free_Node(usNode);
00698 
00699     RootSync();
00700 
00701     return usNode;
00702 }
00703 
00704 //---------------------------------------------------------------------------
00705 K_USHORT NLFS::Delete_File( const K_CHAR *szPath_)
00706 {
00707     K_USHORT usNode = Find_File(szPath_);
00708     K_ULONG ulCurr;
00709     K_ULONG ulPrev;
00710     NLFS_Node_t stNode;
00711     NLFS_Block_t stBlock;
00712 
00713     if (INVALID_NODE == usNode)
00714     {
00715         DEBUG_PRINT("Delete_File: File not found!\n");
00716         return INVALID_NODE;
00717     }
00718     if (FS_ROOT_BLOCK == usNode || FS_CONFIG_BLOCK == usNode)
00719     {
00720         DEBUG_PRINT("Delete_File: Cannot delete root!\n");
00721         return INVALID_NODE;
00722     }
00723 
00724     Read_Node(usNode, &stNode);
00725 
00726     if (NLFS_NODE_DIR == stNode.eBlockType)
00727     {
00728         DEBUG_PRINT("Delete_File: Path is not a file (is it a directory?)");
00729         return INVALID_NODE;
00730     }
00731 
00732     Cleanup_Node_Links(usNode, &stNode);
00733     ulCurr = stNode.stFileNode.ulFirstBlock;
00734 
00735     while (INVALID_BLOCK != ulCurr)
00736     {
00737         Read_Block_Header(ulCurr, &stBlock);
00738 
00739         ulPrev = ulCurr;
00740         ulCurr = stBlock.ulNextBlock;
00741 
00742         Push_Free_Block(ulPrev);
00743     }
00744 
00745     stNode.eBlockType = NLFS_NODE_FREE;
00746 
00747     Write_Node(usNode, &stNode);
00748     Push_Free_Node(usNode);
00749 
00750     RootSync();
00751 
00752     return usNode;
00753 }
00754 
00755 //---------------------------------------------------------------------------
00756 void NLFS::Format(NLFS_Host_t *puHost_, K_ULONG ulTotalSize_, K_USHORT usNumFiles_,
      K_USHORT usDataBlockSize_)
00757 {
00758     K_ULONG i;
```

```
00759     K_ULONG ulNumBlocks;
00760
00761     NLFS_Node_t  stFileNode;
00762     NLFS_Block_t stFileBlock;
00763
00764     // Compute number of data blocks (based on FS Size and the number of file blocks)
00765     ulTotalSize_ -= ((K_ULONG)usNumFiles_) * sizeof(stFileNode);
00766     ulNumBlocks = ulTotalSize_ / ((((K_ULONG)usDataBlockSize_) + (sizeof(stFileBlock) - 1) + 3 ) & ~3);
00767
00768     DEBUG_PRINT("Number of blocks %d\n", ulNumBlocks);
00769
00770     // Set up the local_pointer -> this is used for the low-level, platform-specific
00771     // bits, allowing the FS to be used on RAM buffers, EEPROM's, networks, etc.
00772     m_puHost = puHost_;
00773
00774     // Set the local copies of the data block byte-offset, as well as the data-block size
00775     m_stLocalRoot.usNumFiles        = usNumFiles_;
00776     m_stLocalRoot.usNumFilesFree    = m_stLocalRoot.
      usNumFiles - 2;
00777     m_stLocalRoot.usNextFreeNode    = 2;
00778
00779     m_stLocalRoot.ulNumBlocks       = ulNumBlocks;
00780     m_stLocalRoot.ulNumBlocksFree   = ulNumBlocks;
00781     m_stLocalRoot.ulNextFreeBlock   = 0;
00782
00783     m_stLocalRoot.ulBlockSize       = ((((K_ULONG)usDataBlockSize_) + 3 ) & ~3 );
00784     m_stLocalRoot.ulBlockOffset     = (((K_ULONG)usNumFiles_) * sizeof(
      NLFS_Node_t));
00785     m_stLocalRoot.ulDataOffset      = m_stLocalRoot.
      ulBlockOffset
00786                                       + (((K_ULONG)ulNumBlocks) * sizeof(
      NLFS_Block_t));
00787
00788     // Create root data block node
00789     MemUtil::CopyMemory(&(stFileNode.stRootNode), &
      m_stLocalRoot, sizeof(m_stLocalRoot));
00790     stFileNode.eBlockType = NLFS_NODE_ROOT;
00791
00792     DEBUG_PRINT("Writing root node\n");
00793     Write_Node(0, &stFileNode);
00794     DEBUG_PRINT("Done\n");
00795
00796     // Create root mount point (directory)
00797     MemUtil::SetMemory(&stFileNode, 0, sizeof(stFileNode));
00798     stFileNode.eBlockType = NLFS_NODE_DIR;
00799
00800     stFileNode.stFileNode.acFileName[0] = '/';
00801
00802     stFileNode.stFileNode.usNextPeer   = INVALID_NODE;
00803     stFileNode.stFileNode.usPrevPeer   = INVALID_NODE;
00804     stFileNode.stFileNode.ucGroup      = 0;
00805     stFileNode.stFileNode.ucUser       = 0;
00806     stFileNode.stFileNode.usPerms      = PERM_U_ALL | PERM_G_ALL | PERM_O_ALL;
00807
00808     stFileNode.stFileNode.usParent     = INVALID_NODE;
00809     stFileNode.stFileNode.usChild      = INVALID_NODE;
00810
00811     stFileNode.stFileNode.ulAllocSize  = 0;
00812     stFileNode.stFileNode.ulFileSize   = 0;
00813
00814     stFileNode.stFileNode.ulFirstBlock = INVALID_BLOCK;
00815     stFileNode.stFileNode.ulLastBlock  = INVALID_BLOCK;
00816
00817     DEBUG_PRINT("Writing mount point\n");
00818     Write_Node(1, &stFileNode);
00819     DEBUG_PRINT("Done\n");
00820
00821     stFileNode.stFileNode.acFileName[0] = 0;
00822     // Format nodes
00823     for (i = 2; i < usNumFiles_; i++)
00824     {
00825         stFileNode.eBlockType = NLFS_NODE_FREE;
00826         if (i != usNumFiles_ - 1)
00827         {
00828             stFileNode.stFileNode.usNextPeer = (K_USHORT)(i + 1);
00829         }
00830         else
00831         {
00832             stFileNode.stFileNode.usNextPeer = INVALID_NODE;
00833         }
00834
00835         Write_Node(i, &stFileNode);
00836     }
00837     DEBUG_PRINT("File nodes formatted\n");
00838
00839     // Format file blocks
00840     MemUtil::SetMemory(&stFileBlock, 0, sizeof(stFileBlock));
```

```
00841
00842     DEBUG_PRINT("Writing file blocks\n");
00843     for (i = 0; i < ulNumBlocks; i++)
00844     {
00845         if (i == ulNumBlocks - 1)
00846         {
00847             stFileBlock.ulNextBlock = INVALID_BLOCK;
00848         }
00849         else
00850         {
00851             stFileBlock.ulNextBlock = i + 1;
00852         }
00853
00854         Write_Block_Header(i, &stFileBlock);
00855     }
00856 }
00857
00858 //---------------------------------------------------------------------------
00859 void NLFS::Mount(NLFS_Host_t *puHost_)
00860 {
00861     NLFS_Node_t stRootNode;
00862
00864     m_puHost = puHost_;
00865     DEBUG_PRINT("Remounting FS %X - reading config node\n", puHost_);
00866
00867     // Reload the root block into the local cache
00868     Read_Node(FS_CONFIG_BLOCK, &stRootNode);
00869
00870     DEBUG_PRINT("Copying config node\n");
00871     MemUtil::CopyMemory(&m_stLocalRoot, &(stRootNode.
      stRootNode), sizeof(m_stLocalRoot));
00872
00873     DEBUG_PRINT("Block Size", m_stLocalRoot.ulBlockSize );
00874     DEBUG_PRINT("Data Offset", m_stLocalRoot.ulDataOffset );
00875     DEBUG_PRINT("Block Offset", m_stLocalRoot.ulBlockOffset );
00876 }
00877
00878 //---------------------------------------------------------------------------
00879 void NLFS::RootSync()
00880 {
00881     NLFS_Node_t stRootNode;
00882
00883     MemUtil::CopyMemory(&(stRootNode.stRootNode), &
      m_stLocalRoot, sizeof(m_stLocalRoot));
00884     stRootNode.eBlockType = NLFS_NODE_ROOT;
00885     Write_Node(FS_CONFIG_BLOCK, &stRootNode);
00886 }
00887
00888
00889 //---------------------------------------------------------------------------
00890 K_USHORT NLFS::GetFirstChild( K_USHORT usNode_ )
00891 {
00892     NLFS_Node_t stTemp;
00893     if (!usNode_ || INVALID_NODE == usNode_)
00894     {
00895         return INVALID_NODE;
00896     }
00897     Read_Node(usNode_, &stTemp);
00898
00899     if (stTemp.eBlockType != NLFS_NODE_DIR)
00900     {
00901         return INVALID_NODE;
00902     }
00903
00904     return stTemp.stFileNode.usChild;
00905 }
00906
00907 //---------------------------------------------------------------------------
00908 K_USHORT NLFS::GetNextPeer( K_USHORT usNode_ )
00909 {
00910     NLFS_Node_t stTemp;
00911     if (!usNode_ || INVALID_NODE == usNode_)
00912     {
00913         return INVALID_NODE;
00914     }
00915     Read_Node(usNode_, &stTemp);
00916     return stTemp.stFileNode.usNextPeer;
00917 }
00918
00919 //---------------------------------------------------------------------------
00920 K_BOOL NLFS::GetStat( K_USHORT usNode_, NLFS_File_Stat_t *pstStat_)
00921 {
00922     NLFS_Node_t stTemp;
00923     if (!usNode_ || INVALID_NODE == usNode_)
00924     {
00925         return false;
00926     }
```

```
00927     Read_Node(usNode_, &stTemp);
00928     pstStat_->ulAllocSize = stTemp.stFileNode.ulAllocSize;
00929     pstStat_->ulFileSize = stTemp.stFileNode.ulFileSize;
00930     pstStat_->ucGroup = stTemp.stFileNode.ucGroup;
00931     pstStat_->ucUser = stTemp.stFileNode.ucUser;
00932     pstStat_->usPerms = stTemp.stFileNode.usPerms;
00933     MemUtil::CopyMemory(pstStat_->acFileName, stTemp.
      stFileNode.acFileName, 16);
00934     return true;
00935 }
00936
```

14.115 /home/moslevin2/mark3/embedded/stage/src/nlfs.h File Reference

Nice Little Filesystem (NLFS) - a simple, embeddable filesystem.

```
#include "kerneltypes.h"
#include <stdint.h>
```

Classes

- struct NLFS_File_Node_t

  Data structure for the "file" FS-node type.
- struct NLFS_Root_Node_t

  Data structure for the Root-configuration FS-node type.
- struct NLFS_Node_t

  Filesystem node data structure.
- struct NLFS_Block_t

  Block data structure.
- union NLFS_Host_t

  Union used for managing host-specific pointers/data-types.
- struct NLFS_File_Stat_t

  Structure used to report the status of a given file.
- class NLFS

  Nice Little File System class.

Macros

- #define PERM_UX (0x0001)

  Permission bit definitions.
- #define **PERM_UW** (0x0002)
- #define **PERM_UR** (0x0004)
- #define **PERM_U_ALL** (PERM_UX | PERM_UW | PERM_UR)
- #define **PERM_GX** (0x0008)
- #define **PERM_GW** (0x0010)
- #define **PERM_GR** (0x0020)
- #define **PERM_G_ALL** (PERM_GX | PERM_GW | PERM_GR)
- #define **PERM_OX** (0x0040)
- #define **PERM_OW** (0x0080)
- #define **PERM_OR** (0x0100)
- #define **PERM_O_ALL** (PERM_OX | PERM_OW | PERM_OR)
- #define **INVALID_BLOCK** (0xFFFFFFFF)
- #define **INVALID_NODE** (0xFFFF)
- #define **FILE_NAME_LENGTH** (16)
- #define **FS_CONFIG_BLOCK** (0)
- #define **FS_ROOT_BLOCK** (1)

Enumerations

- enum NLFS_Type_t {
  NLFS_NODE_FREE, NLFS_NODE_ROOT, NLFS_NODE_FILE, NLFS_NODE_DIR,
  FILE_BLOCK_COUNTS }

  Enumeration describing the various types of filesystem nodes used by NLFS.

14.115.1 Detailed Description

Nice Little Filesystem (NLFS) - a simple, embeddable filesystem. Introduction to the Nice-Little-Filesystem (NLFS)

NLFS is yet-another filesystem intended for use in embedded applications.

It is intended to be portable, lightweight, and flexible in terms of supporting different types of physical storage media. In order to ensure that it's easily embeddable, there are no external library dependencies, aside from library code provided elsewhere in Mark3 (namely the MemUtil utility class). Balancing code-size with features and functionality is also a tradeoff - NLFS supports basic operations (create file, create directory, read, write, seek, and delete), without a lot of other bells and whistles. One other feature built into the filesystem is posix-style user-group permissions. While the APIs in the NLFS classes do not enforce permissions explicitly, application-specific implementations of NLFS can enforce permissions based on facilities based on the security mechanisms built into the host OS.

The original purpose of this filesystem was to provide a flexible way of packaging files for read-only use within Mark3 (such as scripts and compiled DCPU-16 objects). However, there are all sorts of purposes for this type of filesystem - essentially, any application where a built-in file manifest or resource container format.

NLFS is a block-based filesystem, composed of three separate regions of data structures within a linearly-addressed blob of storage. These regions are represented on the physical storage in the following order:

[File Nodes][Data Block Headers][Block Data]

The individual regions are as follows:

1) File Nodes

This region is composed of a linear array of equally-sized file-node (NLFS_Node_t) structures, starting at byte offset 0 in the underlying media.

Each node defines a particular file or directory within the filesystem. Because of the linear layout of the filesystem, the file nodes are all pre-allocated during the time of filesystem creation. As a result, care should be taken to ensure enough file nodes are allocated to meet the needs of your application, without wasting space in the filesystem for nodes that will never be needed.

The first two nodes (node 0 and node 1) are special in the NLFS implementation.

Node 0 is also known as the root filesystem node. This block contains a different internal data strucure from other file nodes, and stores the configuration information for the particular filesystem, such as the number of file nodes, file blocks, block sizes, as well as indexes of the first free file and block nodes in the filesystem. With this information, it is possible to re-mount a filesystem created once in another location.

Node 1 is the mount-point for the filesystem, and is the root directory under which all other files and directories are found. By default Node 1 is simply named "/".

2) Block Headers

The block header region of the system comes after the file node region, and consists of a linear array of block node data structures. All storage in a filesystem not allocated towards file nodes is automatically allocated towards data blocks, and for each data block allocated, there is a block node data structure allocated within the block node region.

The NLFS_Block_t data structure contains a link to the next node in a block chain. If the block is free, the link points to the index of the next free block in the filesystem. If allocated, the link points to the index of the next block in the file. This structure also contains flags which indicate whether or not a block is free or allocated, and other flags used for filesystem continuity checks.

3) Block Data

The block data region is the last linear range in the filesystem, and consists of equally-sized blocks in the filesystem. Each block consists of a region of raw physical storage, without any additional metadata.

The contents of any files read or written to the filesystem is stored within the blocks in this region.

The NLFS Class has a number of virtual methods, which require that a user provides an implementaiton appropriate for the underlying physical storage medium from within a class inheriting NLFS.s

An example implemention for a RAM-based filesystem is provided in the NLFS_RAM class located within nlfs_ram.-cpp.

Definition in file nlfs.h.

14.115.2 Enumeration Type Documentation

14.115.2.1 enum NLFS_Type_t

Enumeration describing the various types of filesystem nodes used by NLFS.

A fileysstem node is a fixed-sized data structure consisting of a type specifier, and a union of the data structures representing each possible block type.

Enumerator

NLFS_NODE_FREE File node is free.

NLFS_NODE_ROOT Root filesystem descriptor.

NLFS_NODE_FILE File node.

NLFS_NODE_DIR Directory node.

Definition at line 152 of file nlfs.h.

14.116 nlfs.h

```
00001 /*===========================================================================
00002     _____           _____           _____           _____
00003  ___|    _|__   __|_    |__   __|__    |__   __| __   |__  _______
00004 |    \  /  | ||    \       ||      |      ||  |/ /      ||___    |
00005 |     \/   | ||     \      ||      \      ||     \      ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||_______|
00007    |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2013 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00108 #ifndef __NLFS_H__
00109 #define __NLFS_H__
00110
00111 #include "kerneltypes.h"
00112 #include <stdint.h>
00113
00114 class NLFS_File;
00115
00116 //---------------------------------------------------------------------------
00120 #define PERM_UX     (0x0001)
00121 #define PERM_UW     (0x0002)
00122 #define PERM_UR     (0x0004)
00123 #define PERM_U_ALL  ( PERM_UX | PERM_UW | PERM_UR )
00124
00125 #define PERM_GX     (0x0008)
00126 #define PERM_GW     (0x0010)
00127 #define PERM_GR     (0x0020)
00128 #define PERM_G_ALL  ( PERM_GX | PERM_GW | PERM_GR )
00129
00130 #define PERM_OX     (0x0040)
00131 #define PERM_OW     (0x0080)
00132 #define PERM_OR     (0x0100)
00133 #define PERM_O_ALL  ( PERM_OX | PERM_OW | PERM_OR )
00134
00135 //---------------------------------------------------------------------------
```

```
00136 #define INVALID_BLOCK   (0xFFFFFFFF)
00137 #define INVALID_NODE    (0xFFFF)
00138
00139 //---------------------------------------------------------------------------
00140 #define FILE_NAME_LENGTH    (16)
00141
00142 #define FS_CONFIG_BLOCK     (0)
00143 #define FS_ROOT_BLOCK       (1)
00144
00145 //---------------------------------------------------------------------------
00152 typedef enum
00153 {
00154     NLFS_NODE_FREE,
00155     NLFS_NODE_ROOT,
00156     NLFS_NODE_FILE,
00157     NLFS_NODE_DIR,
00158 // --
00159     FILE_BLOCK_COUNTS
00160 } NLFS_Type_t;
00161
00162 //---------------------------------------------------------------------------
00168 typedef struct
00169 {
00170     K_CHAR      acFileName[16];
00171
00172     K_USHORT    usNextPeer;
00173     K_USHORT    usPrevPeer;
00174
00175     K_UCHAR     ucGroup;
00176     K_UCHAR     ucUser;
00177     K_USHORT    usPerms;
00178
00179     K_USHORT    usParent;
00180     K_USHORT    usChild;
00181
00182 //-- File-specific
00183     K_ULONG     ulAllocSize;
00184     K_ULONG     ulFileSize;
00185
00186     K_ULONG     ulFirstBlock;
00187     K_ULONG     ulLastBlock;
00188 } NLFS_File_Node_t;
00189
00190 //---------------------------------------------------------------------------
00194 typedef struct
00195 {
00196     K_USHORT    usNumFiles;
00197     K_USHORT    usNumFilesFree;
00198     K_USHORT    usNextFreeNode;
00199
00200     K_ULONG     ulNumBlocks;
00201     K_ULONG     ulNumBlocksFree;
00202     K_ULONG     ulNextFreeBlock;
00203
00204     K_ULONG     ulBlockSize;
00205     K_ULONG     ulBlockOffset;
00206     K_ULONG     ulDataOffset;
00207 } NLFS_Root_Node_t;
00208
00209 //---------------------------------------------------------------------------
00215 typedef struct
00216 {
00217     NLFS_Type_t     eBlockType;
00218
00219     union   // Depending on the block type, we use one of the following
00220     {
00221         NLFS_Root_Node_t        stRootNode;
00222         NLFS_File_Node_t        stFileNode;
00223     };
00224 } NLFS_Node_t;
00225
00226 //---------------------------------------------------------------------------
00232 typedef struct
00233 {
00234     K_ULONG     ulNextBlock;
00235     union
00236     {
00237         K_UCHAR     ucFlags;
00238         struct
00239         {
00240             unsigned int    uAllocated;
00241             unsigned int    uCheckBit;
00242         };
00243     };
00244 } NLFS_Block_t;
00245
00246
```

```
00247 //---------------------------------------------------------------------------
00253 typedef union
00254 {
00255     void *pvData;
00256     uint32_t u32Data;
00257     uint64_t u64Data;
00258     K_ADDR kaData;
00259 } NLFS_Host_t;
00260
00261
00262 //---------------------------------------------------------------------------
00266 typedef struct
00267 {
00268     K_ULONG   ulAllocSize;
00269     K_ULONG   ulFileSize;
00270     K_USHORT  usPerms;
00271     K_UCHAR   ucUser;
00272     K_UCHAR   ucGroup;
00273     K_CHAR    acFileName[16];
00274 } NLFS_File_Stat_t;
00275
00276 //---------------------------------------------------------------------------
00280 class NLFS
00281 {
00282 friend class NLFS_File;
00283 public:
00284
00311     void Format(NLFS_Host_t *puHost_, K_ULONG ulTotalSize_, K_USHORT usNumFiles_, K_USHORT
       usDataBlockSize_);
00312
00318     void Mount(NLFS_Host_t *puHost_);
00319
00326     K_USHORT Create_File(const K_CHAR *szPath_);
00327
00334     K_USHORT Create_Dir(const K_CHAR *szPath_);
00335
00341     K_USHORT Delete_File(const K_CHAR *szPath_);
00342
00348     K_USHORT Delete_Folder(const K_CHAR *szPath_);
00349
00356     void Cleanup_Node_Links(K_USHORT usNode_, NLFS_Node_t *pstNode_);
00357
00364     K_USHORT Find_Parent_Dir(const K_CHAR *szPath_);
00365
00371     K_USHORT Find_File(const K_CHAR *szPath_);
00372
00376     void Print(void);
00377
00382     K_ULONG GetBlockSize(void) { return m_stLocalRoot.
      ulBlockSize; }
00383
00388     K_ULONG GetNumBlocks(void) { return m_stLocalRoot.
      ulNumBlocks; }
00389
00395     K_ULONG GetNumBlocksFree(void) { return m_stLocalRoot.
      ulNumBlocksFree; }
00396
00401     K_ULONG GetNumFiles(void)  { return m_stLocalRoot.
      usNumFiles; }
00402
00407     K_USHORT GetNumFilesFree(void) { return m_stLocalRoot.
      usNumFilesFree; }
00408
00409
00417     K_USHORT GetFirstChild( K_USHORT usNode_ );
00418
00424     K_USHORT GetNextPeer( K_USHORT usNode_ );
00425
00432     K_BOOL GetStat( K_USHORT usNode_, NLFS_File_Stat_t *pstStat_);
00433
00434 protected:
00435
00442     K_CHAR Find_Last_Slash(const K_CHAR *szPath_);
00443
00451     K_BOOL File_Names_Match(const K_CHAR *szPath_, NLFS_Node_t *pstNode_);
00452
00459     virtual void Read_Node(K_USHORT usNode_, NLFS_Node_t *pstNode_) = 0;
00460
00467     virtual void Write_Node(K_USHORT usNode_, NLFS_Node_t *pstNode_) = 0;
00468
00475     virtual void Read_Block_Header(K_ULONG ulBlock_,
      NLFS_Block_t *pstBlock_) = 0;
00476
00483     virtual void Write_Block_Header(K_ULONG ulBlock_,
      NLFS_Block_t *pstFileBlock_) = 0;
00484
00494     virtual void Read_Block(K_ULONG ulBlock_, K_ULONG ulOffset_, void *pvData_, K_ULONG ulLen_) =
```

```
    0;
00495
00506     virtual void Write_Block(K_ULONG ulBlock_, K_ULONG ulOffset_, void *pvData_, K_ULONG ulLen_)
    = 0;
00507
00514     void RootSync();
00515
00520     void Repair() {}
00521
00526     void Print_Free_Details( K_USHORT usNode_);
00527
00528
00533     void Print_File_Details(K_USHORT usNode_);
00534
00539     void Print_Dir_Details(K_USHORT usNode_);
00540
00546     void Print_Node_Details(K_USHORT usNode_);
00547
00552     void Push_Free_Node(K_USHORT usNode_);
00553
00558     K_USHORT Pop_Free_Node(void);
00559
00565     void Push_Free_Block(K_ULONG ulBlock_);
00566
00572     K_ULONG Pop_Free_Block(void);
00573
00579     K_ULONG Append_Block_To_Node(NLFS_Node_t *pstFile_);
00580
00587     K_USHORT Create_File_i(const K_CHAR *szPath_, NLFS_Type_t eType_);
00588
00594     void Set_Node_Name( NLFS_Node_t *pstFileNode_, const K_CHAR *szPath_ );
00595
00596     NLFS_Host_t *m_puHost;
00597     NLFS_Root_Node_t m_stLocalRoot;
00598 };
00599
00600 #endif
```

14.117 /home/moslevin2/mark3/embedded/stage/src/nlfs_config.h File Reference

NLFS configuration parameters.

Macros

- #define **DEBUG** 0
- #define **DEBUG_PRINT**(...)

14.117.1 Detailed Description

NLFS configuration parameters.

Definition in file nlfs_config.h.

14.118 nlfs_config.h

```
00001 /*===========================================================================
00002       _____        _____        _____        _____
00003  ____|     |__  __|_    |__  __|__   |__  __| __  |__  ______
00004 |     \   /  | ||    \      ||      |     ||  |/ /     ||___   |
00005 |      \/    | ||     \     ||      \     ||     \     ||___   |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2013 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00019 #ifndef __NLFS_CONFIG_H
00020 #define __NLFS_CONFIG_H
00021
```

```
00022 #define DEBUG       0
00023
00024 #if DEBUG
00025  #include <stdio.h>
00026  #include <stdlib.h>
00027  #define DEBUG_PRINT     printf
00028 #else
00029  #define DEBUG_PRINT(...)
00030 #endif
00031
00032
00033 #endif // NLFS_CONFIG_H
```

14.119 /home/moslevin2/mark3/embedded/stage/src/nlfs_file.cpp File Reference

Nice Little Filesystem - File Access Class.

```
#include "kerneltypes.h"
#include "memutil.h"
#include "nlfs_file.h"
#include "nlfs.h"
#include "nlfs_config.h"
```

14.119.1 Detailed Description

Nice Little Filesystem - File Access Class.

Definition in file nlfs_file.cpp.

14.120 nlfs_file.cpp

```
00001 /*===========================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__   ___|_    |__   ___|__    |__   ___| __   |__   ______
00004 |    \   /   | ||     \       ||      |     ||   |/ /     ||___    |
00005 |     \/    | ||      \      ||      \     ||     \      ||___    |
00006 |__/\__/|__|_||__|\__\   __||__|\__\   __||__|\__\   __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]-----------------------------------------------
00010
00011 Copyright (c) 2013 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00019 #include "kerneltypes.h"
00020 #include "memutil.h"
00021 #include "nlfs_file.h"
00022 #include "nlfs.h"
00023 #include "nlfs_config.h"
00024
00025 //---------------------------------------------------------------------------
00026 int NLFS_File::Open(NLFS *pclFS_, const K_CHAR *szPath_, NLFS_File_Mode_t eMode_)
00027 {
00028     K_USHORT usNode;
00029     usNode = pclFS_->Find_File(szPath_);
00030
00031     if (INVALID_NODE == usNode)
00032     {
00033         DEBUG_PRINT("file does not exist in path\n");
00034         if (eMode_ & NLFS_FILE_CREATE)
00035         {
00036             DEBUG_PRINT("Attempt to create\n");
00037             usNode = pclFS_->Create_File(szPath_);
00038             if (INVALID_NODE == usNode)
00039             {
00040                 DEBUG_PRINT("unable to create node in path\n");
00041                 return -1;
00042             }
00043         }
00044         else
00045         {
```

```
00046             return -1;
00047         }
00048     }
00049
00050     DEBUG_PRINT("Current Node: %d\n", usNode);
00051
00052     m_pclFileSystem = pclFS_;
00053     m_pclFileSystem->Read_Node(usNode, &m_stNode);
00054
00055     m_usFile = usNode;
00056
00057     if (eMode_ & NLFS_FILE_APPEND)
00058     {
00059         if (!(eMode_ & NLFS_FILE_WRITE))
00060         {
00061             DEBUG_PRINT("Open file for append in read-only mode?  Why!\n");
00062             return -1;
00063         }
00064         if (-1 == Seek(m_stNode.stFileNode.ulFileSize))
00065         {
00066             DEBUG_PRINT("file open failed - error seeking to EOF for append\n");
00067             return -1;
00068         }
00069
00070     }
00071     else if (eMode_ & NLFS_FILE_TRUNCATE)
00072     {
00073         if (!(eMode_ & NLFS_FILE_WRITE))
00074         {
00075             DEBUG_PRINT("Truncate file in read-only mode?  Why!\n");
00076             return -1;
00077         }
00078
00079         K_ULONG ulCurr = m_stNode.stFileNode.ulFirstBlock;
00080         K_ULONG ulPrev = ulCurr;
00081
00082         // Go through and clear all blocks allocated to the file
00083         while (INVALID_BLOCK != ulCurr)
00084         {
00085             NLFS_Block_t stBlock;
00086             pclFS_->Read_Block_Header(ulCurr, &stBlock);
00087
00088             ulPrev = ulCurr;
00089             ulCurr = stBlock.ulNextBlock;
00090
00091             pclFS_->Push_Free_Block(ulPrev);
00092         }
00093
00094         m_ulOffset = 0;
00095         m_ulCurrentBlock = m_stNode.stFileNode.
    ulFirstBlock;
00096     }
00097     else
00098     {
00099         // Open file to beginning of file, regardless of mode.
00100         m_ulOffset = 0;
00101         m_ulCurrentBlock = m_stNode.stFileNode.
    ulFirstBlock;
00102     }
00103
00104     m_ucFlags = eMode_;
00105
00106     DEBUG_PRINT("Current Block: %d\n", m_ulCurrentBlock);
00107     DEBUG_PRINT("file open OK\n");
00108     return 0;
00109 }
00110
00111 //---------------------------------------------------------------------------
00112 int NLFS_File::Seek(K_ULONG ulOffset_)
00113 {
00114     NLFS_Block_t stBlock;
00115     m_ulCurrentBlock = m_stNode.stFileNode.
    ulFirstBlock;
00116     m_ulOffset = ulOffset_;
00117
00118     if (INVALID_NODE == m_usFile)
00119     {
00120         DEBUG_PRINT("Error - invalid file");
00121         return -1;
00122     }
00123
00124     if (INVALID_BLOCK == m_ulCurrentBlock)
00125     {
00126         DEBUG_PRINT("Invalid block\n");
00127         m_ulOffset = 0;
00128         return -1;
00129     }
```

```
00130
00131     m_pclFileSystem->Read_Block_Header(
      m_ulCurrentBlock, &stBlock);
00132
00133     while (ulOffset_ >= m_pclFileSystem->GetBlockSize())
00134     {
00135         ulOffset_ -= m_pclFileSystem->GetBlockSize();
00136         m_ulCurrentBlock = stBlock.ulNextBlock;
00137         if ((ulOffset_) && (INVALID_BLOCK == m_ulCurrentBlock))
00138         {
00139             m_ulCurrentBlock = m_stNode.stFileNode.
      ulFirstBlock;
00140             m_ulOffset = 0;
00141             return -1;
00142         }
00143         m_pclFileSystem->Read_Block_Header(
      m_ulCurrentBlock, &stBlock);
00144     }
00145
00146     m_ulOffset = ulOffset_;
00147     return 0;
00148 }
00149
00150 //---------------------------------------------------------------------------
00151 int NLFS_File::Read(void *pvBuf_, K_ULONG ulLen_)
00152 {
00153     K_ULONG ulBytesLeft;
00154     K_ULONG ulOffset;
00155     K_ULONG ulRead = 0;
00156     K_BOOL bBail = false;
00157
00158     K_CHAR *szCharBuf = (K_CHAR*)pvBuf_;
00159
00160     if (INVALID_NODE == m_usFile)
00161     {
00162         DEBUG_PRINT("Error - invalid file");
00163         return -1;
00164     }
00165
00166     if (!(NLFS_FILE_READ & m_ucFlags))
00167     {
00168         DEBUG_PRINT("Error - file not open for read\n");
00169         return -1;
00170     }
00171
00172     DEBUG_PRINT("Reading: %d bytes from file\n", ulLen_);
00173     while (ulLen_ && !bBail)
00174     {
00175         ulOffset = m_ulOffset & (m_pclFileSystem->
      GetBlockSize() - 1);
00176         ulBytesLeft = m_pclFileSystem->GetBlockSize() - ulOffset;
00177         if (ulBytesLeft > ulLen_)
00178         {
00179             ulBytesLeft = ulLen_;
00180         }
00181         if (m_ulOffset + ulBytesLeft >= m_stNode.stFileNode.
      ulFileSize)
00182         {
00183             ulBytesLeft = m_stNode.stFileNode.ulFileSize -
      m_ulOffset;
00184             bBail = true;
00185         }
00186
00187         DEBUG_PRINT( "%d bytes left in block, %d len, %x block\n", ulBytesLeft, ulLen_,
      m_ulCurrentBlock);
00188         if (ulBytesLeft && ulLen_ && (INVALID_BLOCK != m_ulCurrentBlock))
00189         {
00190             m_pclFileSystem->Read_Block(
      m_ulCurrentBlock, ulOffset, (void*)szCharBuf, ulBytesLeft );
00191
00192             ulRead += ulBytesLeft;
00193             ulLen_ -= ulBytesLeft;
00194             szCharBuf += ulBytesLeft;
00195             m_ulOffset += ulBytesLeft;
00196             DEBUG_PRINT( "%d bytes to go\n", ulLen_);
00197         }
00198         if (ulLen_)
00199         {
00200             DEBUG_PRINT("reading next node\n");
00201             NLFS_Block_t stBlock;
00202             m_pclFileSystem->Read_Block_Header(
      m_ulCurrentBlock, &stBlock);
00203             m_ulCurrentBlock = stBlock.ulNextBlock;
00204         }
00205
00206         if (INVALID_BLOCK == m_ulCurrentBlock)
00207         {
```

```
00208             break;
00209         }
00210 
00211     }
00212     DEBUG_PRINT("Return :%d bytes read\n", ulRead);
00213     return ulRead;
00214 }
00215 
00216 //---------------------------------------------------------------------------
00217 int NLFS_File::Write(void *pvBuf_, K_ULONG ulLen_)
00218 {
00219     K_ULONG ulBytesLeft;
00220     K_ULONG ulOffset;
00221     K_ULONG ulWritten = 0;
00222     K_CHAR *szCharBuf = (K_CHAR*)pvBuf_;
00223 
00224     if (INVALID_NODE == m_usFile)
00225     {
00226         DEBUG_PRINT("Error - invalid file");
00227         return -1;
00228     }
00229 
00230     if (!(NLFS_FILE_WRITE & m_ucFlags))
00231     {
00232         DEBUG_PRINT("Error - file not open for write\n");
00233         return -1;
00234     }
00235 
00236     DEBUG_PRINT("writing: %d bytes to file\n", ulLen_);
00237     while (ulLen_)
00238     {
00239         ulOffset = m_ulOffset & (m_pclFileSystem->
    GetBlockSize() - 1);
00240         ulBytesLeft = m_pclFileSystem->GetBlockSize() - ulOffset;
00241         if (ulBytesLeft > ulLen_)
00242         {
00243             ulBytesLeft = ulLen_;
00244         }
00245         if (ulBytesLeft && ulLen_ && (INVALID_BLOCK != m_ulCurrentBlock))
00246         {
00247             m_pclFileSystem->Write_Block(
    m_ulCurrentBlock, ulOffset, (void*)szCharBuf, ulBytesLeft );
00248             ulWritten += ulBytesLeft;
00249             ulLen_ -= ulBytesLeft;
00250             szCharBuf += ulBytesLeft;
00251             m_stNode.stFileNode.ulFileSize += ulBytesLeft;
00252             m_ulOffset += ulBytesLeft;
00253             DEBUG_PRINT( "%d bytes to go\n", ulLen_);
00254         }
00255         if (!ulLen_)
00256         {
00257             m_pclFileSystem->Write_Node(m_usFile, &
    m_stNode);
00258         }
00259         else
00260         {
00261             DEBUG_PRINT("appending\n");
00262             m_ulCurrentBlock = m_pclFileSystem->
    Append_Block_To_Node(&m_stNode);
00263         }
00264 
00265         DEBUG_PRINT("writing node to file\n");
00266         m_pclFileSystem->Write_Node(m_usFile, &
    m_stNode);
00267     }
00268     return ulWritten;
00269 }
00270 
00271 //---------------------------------------------------------------------------
00272 int NLFS_File::Close(void)
00273 {
00274     m_usFile = INVALID_NODE;
00275     m_ulCurrentBlock = INVALID_BLOCK;
00276     m_ulOffset = 0;
00277     m_ucFlags = 0;
00278     return 0;
00279 }
```

14.121 /home/moslevin2/mark3/embedded/stage/src/nlfs_file.h File Reference

NLFS file access class.

```
#include "kerneltypes.h"
#include "nlfs.h"
#include "nlfs_config.h"
```

Classes

- class NLFS_File

  The NLFS_File class.

Typedefs

- typedef K_UCHAR **NLFS_File_Mode_t**

Enumerations

- enum NLFS_File_Mode {
  NLFS_FILE_CREATE = 0x01, NLFS_FILE_APPEND = 0x02, NLFS_FILE_TRUNCATE = 0x04, NLFS_FILE_READ = 0x08,
  NLFS_FILE_WRITE = 0x10 }

14.121.1 Detailed Description

NLFS file access class.

Definition in file nlfs_file.h.

14.121.2 Enumeration Type Documentation

14.121.2.1 enum NLFS_File_Mode

Enumerator

NLFS_FILE_CREATE Create the file if it does not exist.

NLFS_FILE_APPEND Open to end of file.

NLFS_FILE_TRUNCATE Truncate file size to 0-bytes.

NLFS_FILE_READ Open file for read.

NLFS_FILE_WRITE Open file for write.

Definition at line 27 of file nlfs_file.h.

14.122 nlfs_file.h

```
00001 /*===========================================================================
00002     _____       _____       _____       _____
00003  ___|    _|__  __|_    |__  __|__    |__  __| __  |__  ______
00004 |    \  /  | ||    \       ||      |     ||  |/ /     ||___   |
00005 |     \/   | ||     \      ||      \     ||     \     ||___   |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007    |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]-----------------------------------------------
00010
00011 Copyright (c) 2013 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
```

```
00019 #ifndef __NLFS_FILE_H
00020 #define __NLFS_FILE_H
00021
00022 #include "kerneltypes.h"
00023 #include "nlfs.h"
00024 #include "nlfs_config.h"
00025
00026 //---------------------------------------------------------------------------
00027 typedef enum
00028 {
00029     NLFS_FILE_CREATE = 0x01,
00030     NLFS_FILE_APPEND = 0x02,
00031     NLFS_FILE_TRUNCATE = 0x04,
00032     NLFS_FILE_READ = 0x08,
00033     NLFS_FILE_WRITE = 0x10
00034 } NLFS_File_Mode;
00035 typedef K_UCHAR NLFS_File_Mode_t;
00036
00037 //---------------------------------------------------------------------------
00045 class NLFS_File
00046 {
00047
00048 public:
00056     int     Open(NLFS *pclFS_, const K_CHAR *szPath_, NLFS_File_Mode_t eMode_);
00057
00064     int     Read(void *pvBuf_, K_ULONG ulLen_);
00065
00073     int     Write(void *pvBuf_, K_ULONG ulLen_);
00074
00080     int     Seek(K_ULONG ulOffset_);
00081
00086     int     Close(void);
00087
00088 private:
00089     NLFS                *m_pclFileSystem;
00090     K_ULONG             m_ulOffset;
00091     K_ULONG             m_ulCurrentBlock;
00092     K_USHORT            m_usFile;
00093     NLFS_File_Mode_t    m_ucFlags;
00094     NLFS_Node_t m_stNode;
00095 };
00096
00097 #endif // __NLFS_FILE_H
```

14.123 /home/moslevin2/mark3/embedded/stage/src/nlfs_ram.cpp File Reference

RAM-based Nice Little Filesystem (NLFS) driver.

```
#include "nlfs.h"
#include "nlfs_ram.h"
#include "memutil.h"
#include "nlfs_config.h"
```

14.123.1 Detailed Description

RAM-based Nice Little Filesystem (NLFS) driver.

Definition in file nlfs_ram.cpp.

14.124 nlfs_ram.cpp

```
00001 /*===========================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__    __|_    |__    __|__    |__    __| __   |__   ______
00004 |    \   /   | ||    \       ||      |      ||   |/ /      ||___    |
00005 |     \/    | ||     \      ||      \      ||      \      ||___    |
00006 |__/\__/|__|_||__|\__\   __||__|\__\   __||__|\__\   __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2013 Funkenstein Software Consulting, all rights reserved.
```

```
00012 See license.txt for more information
00013 ============================================================================*/
00019 #include "nlfs.h"
00020 #include "nlfs_ram.h"
00021 #include "memutil.h"
00022 #include "nlfs_config.h"
00023
00024 //---------------------------------------------------------------------------
00025 void NLFS_RAM::Read_Node( K_USHORT usNode_, NLFS_Node_t *pstFileNode_)
00026 {
00027     NLFS_Node_t *pstFileNode =  (NLFS_Node_t*)(m_puHost->kaData
00028                                                 + (usNode_ * sizeof(
      NLFS_Node_t)));
00029
00030     MemUtil::CopyMemory(pstFileNode_, pstFileNode, sizeof(
      NLFS_Node_t));
00031 }
00032
00033 //---------------------------------------------------------------------------
00034 void NLFS_RAM::Write_Node(K_USHORT usNode_, NLFS_Node_t *pstFileNode_)
00035 {
00036     NLFS_Node_t *pstFileNode =  (NLFS_Node_t*)(m_puHost->kaData
00037                                                 + (usNode_ * sizeof(
      NLFS_Node_t)));
00038
00039     MemUtil::CopyMemory(pstFileNode, pstFileNode_, sizeof(
      NLFS_Node_t));
00040 }
00041
00042 //---------------------------------------------------------------------------
00043 void NLFS_RAM::Read_Block_Header(K_ULONG ulBlock_,
      NLFS_Block_t *pstFileBlock_)
00044 {
00045     NLFS_Block_t *pstFileBlock =  (NLFS_Block_t*)(
      m_puHost->kaData
00046                                                 + m_stLocalRoot.
      ulBlockOffset
00047                                                 + (ulBlock_ * sizeof(
      NLFS_Block_t)));
00048
00049     MemUtil::CopyMemory(pstFileBlock_, pstFileBlock, sizeof(
      NLFS_Block_t));
00050 }
00051
00052 //---------------------------------------------------------------------------
00053 void NLFS_RAM::Write_Block_Header(K_ULONG ulBlock_,
      NLFS_Block_t *pstFileBlock_)
00054 {
00055     NLFS_Block_t *pstFileBlock =  (NLFS_Block_t*)(
      m_puHost->kaData
00056                                                 + m_stLocalRoot.
      ulBlockOffset
00057                                                 + (ulBlock_ * sizeof(
      NLFS_Block_t)));
00058
00059     MemUtil::CopyMemory(pstFileBlock, pstFileBlock_, sizeof(
      NLFS_Block_t));
00060 }
00061
00062 //---------------------------------------------------------------------------
00063 void NLFS_RAM::Read_Block(K_ULONG ulBlock_, K_ULONG ulOffset_, void *pvData_, K_ULONG
      ulLen_)
00064 {
00065     void *pvSrc_ = (void*)( m_puHost->kaData
00066                             + m_stLocalRoot.ulDataOffset
00067                             + ulOffset_
00068                             + (ulBlock_ * m_stLocalRoot.ulBlockSize) );
00069     MemUtil::CopyMemory(pvData_, pvSrc_, (K_USHORT)ulLen_);
00070 }
00071
00072 //---------------------------------------------------------------------------
00073 void NLFS_RAM::Write_Block(K_ULONG ulBlock_, K_ULONG ulOffset_, void *pvData_, K_ULONG
       ulLen_)
00074 {
00075     void *pvDst_ = (void*)( m_puHost->kaData
00076                             + m_stLocalRoot.ulDataOffset
00077                             + ulOffset_
00078                             + (ulBlock_ * m_stLocalRoot.ulBlockSize) );
00079     MemUtil::CopyMemory(pvDst_, pvData_, (K_USHORT)ulLen_);
00080 }
```

14.125 /home/moslevin2/mark3/embedded/stage/src/nlfs_ram.h File Reference

RAM-based Nice Little Filesystem (NLFS) driver.

```
#include "nlfs.h"
```

Classes

- class NLFS_RAM

  The NLFS_RAM class.

14.125.1 Detailed Description

RAM-based Nice Little Filesystem (NLFS) driver.

Definition in file nlfs_ram.h.

14.126 nlfs_ram.h

```
00001 /*===========================================================================
00002      _____          _____          _____          _____
00003  ___|    _|__   ___|_    |__   ___|__   |__   ___| __   |__   ______
00004 |    \  /   | ||     \       ||      |     ||   |/ /     ||___    |
00005 |     \/    | ||      \      ||      \     ||      \     ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2013 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00019 #ifndef __NLFS_RAM_H
00020 #define __NLFS_RAM_H
00021
00022 #include "nlfs.h"
00023
00031 class NLFS_RAM : public NLFS
00032 {
00033 private:
00034
00041     virtual void Read_Node(K_USHORT usNode_, NLFS_Node_t *pstNode_);
00042
00049     virtual void Write_Node(K_USHORT usNode_, NLFS_Node_t *pstNode_);
00050
00057     virtual void Read_Block_Header(K_ULONG ulBlock_,
      NLFS_Block_t *pstBlock_);
00058
00065     virtual void Write_Block_Header(K_ULONG ulBlock_,
      NLFS_Block_t *pstFileBlock_);
00066
00076     virtual void Read_Block(K_ULONG ulBlock_, K_ULONG ulOffset_, void *pvData_, K_ULONG ulLen_);
00077
00088     void Write_Block(K_ULONG ulBlock_, K_ULONG ulOffset_, void *pvData_, K_ULONG ulLen_);
00089
00090 };
00091
00092 #endif // NLFS_RAM_H
```

14.127 /home/moslevin2/mark3/embedded/stage/src/profile.cpp File Reference

Code profiling utilities.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "profile.h"
#include "kprofile.h"
#include "threadport.h"
#include "kernel_debug.h"
```

Macros

- #define **__FILE_ID__** PROFILE_CPP

14.127.1 Detailed Description

Code profiling utilities.

Definition in file profile.cpp.

14.128 profile.cpp

```
00001 /*==========================================================================
00002      _____          _____          _____          _____
00003  ___|    _|__   ___|_    |__   ___|__    |__   ___| __   |__  ______
00004 |    \  /   | ||    \       ||      |     ||  |/ /     ||___   |
00005 |     \/    | ||     \      ||      \     ||     \     ||___   |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ==========================================================================*/
00021 #include "kerneltypes.h"
00022 #include "mark3cfg.h"
00023 #include "profile.h"
00024 #include "kprofile.h"
00025 #include "threadport.h"
00026 #include "kernel_debug.h"
00027 //---------------------------------------------------------------------------
00028 #if defined __FILE_ID__
00029     #undef __FILE_ID__
00030 #endif
00031 #define __FILE_ID__     PROFILE_CPP
00032
00033
00034 #if KERNEL_USE_PROFILER
00035
00036 //---------------------------------------------------------------------------
00037 void ProfileTimer::Init()
00038 {
00039     m_ulCumulative = 0;
00040     m_ulCurrentIteration = 0;
00041     m_usIterations = 0;
00042     m_bActive = 0;
00043 }
00044
00045 //---------------------------------------------------------------------------
00046 void ProfileTimer::Start()
00047 {
00048     if (!m_bActive)
00049     {
00050         CS_ENTER();
00051         m_ulCurrentIteration = 0;
00052         m_ulInitialEpoch = Profiler::GetEpoch();
00053         m_usInitial = Profiler::Read();
00054         CS_EXIT();
00055         m_bActive = 1;
00056     }
00057 }
00058
00059 //---------------------------------------------------------------------------
00060 void ProfileTimer::Stop()
```

```
00061 {
00062     if (m_bActive)
00063     {
00064         K_USHORT usFinal;
00065         K_ULONG ulEpoch;
00066         CS_ENTER();
00067         usFinal = Profiler::Read();
00068         ulEpoch = Profiler::GetEpoch();
00069         // Compute total for current iteration...
00070         m_ulCurrentIteration = ComputeCurrentTicks(usFinal, ulEpoch)
    ;
00071         m_ulCumulative += m_ulCurrentIteration;
00072         m_usIterations++;
00073         CS_EXIT();
00074         m_bActive = 0;
00075     }
00076 }
00077
00078 //---------------------------------------------------------------------------
00079 K_ULONG ProfileTimer::GetAverage()
00080 {
00081     if (m_usIterations)
00082     {
00083         return m_ulCumulative / (K_ULONG)m_usIterations;
00084     }
00085     return 0;
00086 }
00087
00088 //---------------------------------------------------------------------------
00089 K_ULONG ProfileTimer::GetCurrent()
00090 {
00091
00092     if (m_bActive)
00093     {
00094         K_USHORT usCurrent;
00095         K_ULONG ulEpoch;
00096         CS_ENTER();
00097         usCurrent = Profiler::Read();
00098         ulEpoch = Profiler::GetEpoch();
00099         CS_EXIT();
00100         return ComputeCurrentTicks(usCurrent, ulEpoch);
00101     }
00102     return m_ulCurrentIteration;
00103 }
00104
00105 //---------------------------------------------------------------------------
00106 K_ULONG ProfileTimer::ComputeCurrentTicks(K_USHORT usCurrent_, K_ULONG
    ulEpoch_)
00107 {
00108     K_ULONG ulTotal;
00109     K_ULONG ulOverflows;
00110
00111     ulOverflows = ulEpoch_ - m_ulInitialEpoch;
00112
00113     // More than one overflow...
00114     if (ulOverflows > 1)
00115     {
00116         ulTotal = ((K_ULONG)(ulOverflows-1) * TICKS_PER_OVERFLOW)
00117                 + (K_ULONG)(TICKS_PER_OVERFLOW - m_usInitial) +
00118                 (K_ULONG)usCurrent_;
00119     }
00120     // Only one overflow, or one overflow that has yet to be processed
00121     else if (ulOverflows || (usCurrent_ < m_usInitial))
00122     {
00123         ulTotal = (K_ULONG)(TICKS_PER_OVERFLOW - m_usInitial) +
00124                 (K_ULONG)usCurrent_;
00125     }
00126     // No overflows, none pending.
00127     else
00128     {
00129         ulTotal = (K_ULONG)(usCurrent_ - m_usInitial);
00130     }
00131
00132     return ulTotal;
00133 }
00134
00135 #endif
```

14.129 /home/moslevin2/mark3/embedded/stage/src/profile.h File Reference

High-precision profiling timers.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "ll.h"
```

Classes

- class ProfileTimer

  Profiling timer.

14.129.1 Detailed Description

High-precision profiling timers. Enables the profiling and instrumentation of performance-critical code. Multiple timers can be used simultaneously to enable system-wide performance metrics to be computed in a lightweight manner.

Usage:

```
ProfileTimer clMyTimer;
int i;

clMyTimer.Init();

// Profile the same block of code ten times
for (i = 0; i < 10; i++)
{
    clMyTimer.Start();
    ...
    //Block of code to profile
    ...
    clMyTimer.Stop();
}

// Get the average execution time of all iterations
ulAverageTimer = clMyTimer.GetAverage();

// Get the execution time from the last iteration
ulLastTimer = clMyTimer.GetCurrent();
```

Definition in file profile.h.

14.130 profile.h

```
00001 /*===========================================================================
00002      _____          _____          _____          _____
00003  ___|    _|__   ___|_    |__   ___|__    |__   ___| __   |__  ______
00004 |    \  /  | ||    \       ||      |     ||  |/ /     ||___   |
00005 |     \/   | ||     \      ||      \     ||     \     ||___   |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00053 #ifndef __PROFILE_H__
00054 #define __PROFILE_H__
00055
00056 #include "kerneltypes.h"
00057 #include "mark3cfg.h"
00058 #include "ll.h"
00059
00060 #if KERNEL_USE_PROFILER
00061
00069 class ProfileTimer
00070 {
00071
00072 public:
00079     void Init();
00080
```

```
    void Start();

    void Stop();

    K_ULONG GetAverage();

    K_ULONG GetCurrent();

private:

    K_ULONG ComputeCurrentTicks(K_USHORT usCount_, K_ULONG ulEpoch_);

    K_ULONG m_ulCumulative;
    K_ULONG m_ulCurrentIteration;
    K_USHORT m_usInitial;
    K_ULONG m_ulInitialEpoch;
    K_USHORT m_usIterations;
    K_UCHAR m_bActive;
};

#endif // KERNEL_USE_PROFILE

#endif
```

14.131 /home/moslevin2/mark3/embedded/stage/src/quantum.cpp File Reference

Thread Quantum Implementation for Round-Robin Scheduling.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "timerlist.h"
#include "thread.h"
#include "quantum.h"
#include "kernel_debug.h"
```

Macros

- #define **__FILE_ID__** QUANTUM_CPP

Functions

- static void **QuantumCallback** (Thread ∗pclThread_, void ∗pvData_)

Variables

- static volatile K_BOOL **bAddQuantumTimer**

14.131.1 Detailed Description

Thread Quantum Implementation for Round-Robin Scheduling.

Definition in file quantum.cpp.

14.132 quantum.cpp

```
/*===========================================================================
     _____        _____        _____        _____
 ___|    _|__  __|_    |__  __|__   |__  __| __  |__  ______
|    \  /  | ||    \      ||     |     ||  |/ /     ||___   |
|     \/   | ||     \     ||     \     ||     \     ||___   |
|__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
```

```
00007     |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00022 #include "kerneltypes.h"
00023 #include "mark3cfg.h"
00024
00025 #include "timerlist.h"
00026 #include "thread.h"
00027 #include "quantum.h"
00028 #include "kernel_debug.h"
00029 //---------------------------------------------------------------------------
00030 #if defined __FILE_ID__
00031     #undef __FILE_ID__
00032 #endif
00033 #define __FILE_ID__     QUANTUM_CPP
00034
00035 #if KERNEL_USE_QUANTUM
00036
00037 //---------------------------------------------------------------------------
00038 static volatile K_BOOL bAddQuantumTimer;    // Indicates that a timer add is pending
00039
00040 //---------------------------------------------------------------------------
00041 Timer Quantum::m_clQuantumTimer;   // The global timernodelist_t object
00042 K_UCHAR Quantum::m_bActive;
00043 //---------------------------------------------------------------------------
00044 static void QuantumCallback(Thread *pclThread_, void *pvData_)
00045 {
00046     // Validate thread pointer, check that source/destination match (it's
00047     // in its real priority list).  Also check that this thread was part of
00048     // the highest-running priority level.
00049     if (pclThread_->GetPriority() >= Scheduler::GetCurrentThread()->
    GetPriority())
00050     {
00051         if (pclThread_->GetCurrent()->GetHead() != pclThread_->
    GetCurrent()->GetTail() )
00052         {
00053             bAddQuantumTimer = true;
00054             pclThread_->GetCurrent()->PivotForward();
00055         }
00056     }
00057 }
00058
00059 //---------------------------------------------------------------------------
00060 void Quantum::SetTimer(Thread *pclThread_)
00061 {
00062     m_clQuantumTimer.SetIntervalMSeconds(pclThread_->
    GetQuantum());
00063     m_clQuantumTimer.SetFlags(TIMERLIST_FLAG_ONE_SHOT);
00064     m_clQuantumTimer.SetData(NULL);
00065     m_clQuantumTimer.SetCallback((TimerCallback_t)QuantumCallback);
00066     m_clQuantumTimer.SetOwner(pclThread_);
00067 }
00068
00069 //---------------------------------------------------------------------------
00070 void Quantum::AddThread(Thread *pclThread_)
00071 {
00072     if (m_bActive)
00073     {
00074         return;
00075     }
00076     // If this isn't the only thread in the list.
00077     if ( pclThread_->GetCurrent()->GetHead() !=
00078            pclThread_->GetCurrent()->GetTail() )
00079     {
00080         Quantum::SetTimer(pclThread_);
00081         TimerScheduler::Add(&m_clQuantumTimer);
00082         m_bActive = 1;
00083     }
00084 }
00085
00086 //---------------------------------------------------------------------------
00087 void Quantum::RemoveThread(void)
00088 {
00089     if (!m_bActive)
00090     {
00091         return;
00092     }
00093
00094     // Cancel the current timer
00095     TimerScheduler::Remove(&m_clQuantumTimer);
00096     m_bActive = 0;
00097 }
00098
```

```
00099 //---------------------------------------------------------------------------
00100 void Quantum::UpdateTimer(void)
00101 {
00102     // If we have to re-add the quantum timer (more than 2 threads at the
00103     // high-priority level...)
00104     if (bAddQuantumTimer)
00105     {
00106         // Trigger a thread yield - this will also re-schedule the
00107         // thread *and* reset the round-robin scheduler.
00108         Thread::Yield();
00109         bAddQuantumTimer = false;
00110     }
00111 }
00112
00113 #endif //KERNEL_USE_QUANTUM
```

14.133 /home/moslevin2/mark3/embedded/stage/src/quantum.h File Reference

Thread Quantum declarations for Round-Robin Scheduling.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "thread.h"
#include "timerlist.h"
```

Classes

- class Quantum

  Static-class used to implement Thread quantum functionality, which is a key part of round-robin scheduling.

14.133.1 Detailed Description

Thread Quantum declarations for Round-Robin Scheduling.

Definition in file quantum.h.

14.134 quantum.h

```
00001 /*===========================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__   ___|_    |__   ___|__    |__   ___| __   |__   ______
00004 |    \  /   | ||    \       ||      |      ||  |/ /     ||___    |
00005 |     \/    | ||     \      ||      \      ||     \     ||___    |
00006 |__/\__/|__|_||__|\__\  ___||__|\__\  ___||__|\__\  ___||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00022 #ifndef __KQUANTUM_H__
00023 #define __KQUANTUM_H__
00024
00025 #include "kerneltypes.h"
00026 #include "mark3cfg.h"
00027
00028 #include "thread.h"
00029 #include "timerlist.h"
00030
00031 #if KERNEL_USE_QUANTUM
00032 class Timer;
00033
00039 class Quantum
00040 {
00041 public:
00050     static void UpdateTimer();
00051
```

```
00058     static void AddThread( Thread *pclThread_ );
00059
00065     static void RemoveThread();
00066
00067 private:
00079     static void SetTimer( Thread *pclThread_ );
00080
00081     static Timer m_clQuantumTimer;
00082     static K_UCHAR m_bActive;
00083 };
00084
00085 #endif //KERNEL_USE_QUANTUM
00086
00087 #endif
```

14.135 /home/moslevin2/mark3/embedded/stage/src/scheduler.cpp File Reference

Strict-Priority + Round-Robin thread scheduler implementation.

```
#include "kerneltypes.h"
#include "ll.h"
#include "scheduler.h"
#include "thread.h"
#include "kernel_debug.h"
```

Macros

- #define **__FILE_ID__** SCHEDULER_CPP

Variables

- Thread * **g_pstNext**
- Thread * **g_pstCurrent**
- K_UCHAR **g_ucFlag**
- static const K_UCHAR **aucCLZ** [16] ={255,0,1,1,2,2,2,2,3,3,3,3,3,3,3,3}

14.135.1 Detailed Description

Strict-Priority + Round-Robin thread scheduler implementation.

Definition in file scheduler.cpp.

14.136 scheduler.cpp

```
00001 /*===========================================================================
00002       _____          _____          _____          _____
00003  ___|    _|__   ___|_    |__   ___|__    |__   ___| __   |__   ______
00004 |    \  /   | ||    \       ||       |     ||   |/ /      ||___    |
00005 |     \/    | ||     \      ||       \     ||      \      ||___    |
00006 |__/\__/|__|_||__|\__\   __||__|\__\   __||__|\__\   __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00022 #include "kerneltypes.h"
00023 #include "ll.h"
00024 #include "scheduler.h"
00025 #include "thread.h"
00026 #include "kernel_debug.h"
00027 //---------------------------------------------------------------------------
```

```
00028 #if defined __FILE_ID__
00029     #undef __FILE_ID__
00030 #endif
00031 #define __FILE_ID__     SCHEDULER_CPP
00032
00033 //---------------------------------------------------------------------------
00034 Thread *g_pstNext;
00035 Thread *g_pstCurrent;
00036
00037 //---------------------------------------------------------------------------
00038 K_UCHAR Scheduler::m_bEnabled;
00039 ThreadList Scheduler::m_clStopList;
00040 ThreadList Scheduler::m_aclPriorities[NUM_PRIORITIES];
00041 K_UCHAR Scheduler::m_ucPriFlag;
00042
00043 K_UCHAR g_ucFlag;
00044 //---------------------------------------------------------------------------
00045 static const K_UCHAR aucCLZ[16] ={255,0,1,1,2,2,2,2,3,3,3,3,3,3,3,3};
00046
00047 //---------------------------------------------------------------------------
00048 void Scheduler::Init()
00049 {
00050     m_ucPriFlag = 0;
00051     for (int i = 0; i < NUM_PRIORITIES; i++)
00052     {
00053         m_aclPriorities[i].SetPriority(i);
00054         m_aclPriorities[i].SetFlagPointer(&
    m_ucPriFlag);
00055     }
00056     g_ucFlag = m_ucPriFlag;
00057 }
00058
00059 //---------------------------------------------------------------------------
00060 void Scheduler::Schedule()
00061 {
00062     K_UCHAR ucPri = 0;
00063
00064     // Figure out what priority level has ready tasks (8 priorities max)
00065     ucPri = aucCLZ[m_ucPriFlag >> 4 ];
00066     if (ucPri == 0xFF) { ucPri = aucCLZ[m_ucPriFlag & 0x0F]; }
00067     else { ucPri += 4; }
00068
00069     // Get the thread node at this priority.
00070     g_pstNext = (Thread*)( m_aclPriorities[ucPri].GetHead() );
00071     g_ucFlag = m_ucPriFlag;
00072
00073     KERNEL_TRACE_1( STR_SCHEDULE_1, (K_USHORT)g_pstNext->GetID() );
00074 }
00075
00076 //---------------------------------------------------------------------------
00077 void Scheduler::Add(Thread *pclThread_)
00078 {
00079     m_aclPriorities[pclThread_->GetPriority()].Add(pclThread_);
00080     g_ucFlag = m_ucPriFlag;
00081 }
00082
00083 //---------------------------------------------------------------------------
00084 void Scheduler::Remove(Thread *pclThread_)
00085 {
00086     m_aclPriorities[pclThread_->GetPriority()].Remove(pclThread_);
00087     g_ucFlag = m_ucPriFlag;
00088 }
```

14.137 /home/moslevin2/mark3/embedded/stage/src/scheduler.h File Reference

Thread scheduler function declarations.

```
#include "kerneltypes.h"
#include "thread.h"
```

Classes

- class Scheduler

  Priority-based round-robin Thread scheduling, using ThreadLists for housekeeping.

Macros

- #define **NUM_PRIORITIES** (8)

Variables

- Thread * **g_pstNext**
- Thread * **g_pstCurrent**

14.137.1 Detailed Description

Thread scheduler function declarations. This scheduler implements a very flexible type of scheduling, which has become the defacto industry standard when it comes to real-time operating systems. This scheduling mechanism is referred to as priority round- robin.

From the name, there are two concepts involved here:

1) Priority scheduling:

Threads are each assigned a priority, and the thread with the highest priority which is ready to run gets to execute.

2) Round-robin scheduling:

Where there are multiple ready threads at the highest-priority level, each thread in that group gets to share time, ensuring that progress is made.

The scheduler uses an array of ThreadList objects to provide the necessary housekeeping required to keep track of threads at the various priorities. As s result, the scheduler contains one ThreadList per priority, with an additional list to manage the storage of threads which are in the "stopped" state (either have been stopped, or have not been started yet).

Definition in file scheduler.h.

14.138 scheduler.h

```
00001 /*=========================================================================
00002      _____          _____          _____          _____
00003  ___|    _|__   __|_    |__   __|__    |__   __| __   |__   ______
00004 |    \  /   | ||    \       ||      |     ||   |/ /     ||___    |
00005 |     \/    | ||     \      ||      \     ||     \      ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 =========================================================================*/
00046 #ifndef __SCHEDULER_H__
00047 #define __SCHEDULER_H__
00048
00049 #include "kerneltypes.h"
00050 #include "thread.h"
00051
00052 extern Thread *g_pstNext;
00053 extern Thread *g_pstCurrent;
00054
00055 #define NUM_PRIORITIES              (8)
00056 //---------------------------------------------------------------------------
00061 class Scheduler
00062 {
00063 public:
00069     static void Init();
00070
00078     static void Schedule();
00079
00087     static void Add(Thread *pclThread_);
00088
00097     static void Remove(Thread *pclThread_);
00098
00111     static void SetScheduler(K_UCHAR bEnable_){ m_bEnabled = bEnable_; }
```

```
00112
00118     static Thread *GetCurrentThread(){ return g_pstCurrent; }
00119
00126     static Thread *GetNextThread(){ return g_pstNext; }
00127
00136     static ThreadList *GetThreadList(K_UCHAR ucPriority_){ return &
      m_aclPriorities[ucPriority_]; }
00137
00144     static ThreadList *GetStopList(){ return &m_clStopList; }
00145
00154     static K_UCHAR IsEnabled(){ return m_bEnabled; }
00155
00156 private:
00158     static K_UCHAR m_bEnabled;
00159
00161     static ThreadList m_clStopList;
00162
00164     static ThreadList m_aclPriorities[NUM_PRIORITIES];
00165
00167     static K_UCHAR m_ucPriFlag;
00168 };
00169 #endif
00170
```

14.139 /home/moslevin2/mark3/embedded/stage/src/screen.cpp File Reference

Higher level window management framework.

```
#include "kerneltypes.h"
#include "screen.h"
#include "gui.h"
#include "memutil.h"
```

14.139.1 Detailed Description

Higher level window management framework.

Definition in file screen.cpp.

14.140 screen.cpp

```
00001 /*===========================================================================
00002      _____          _____          _____          _____
00003  ___|    _|__   ___|_    |__   ___|__   |__   ___| __   |__   ______
00004 |    \  /   | ||     \       ||      |      ||   |/ /      ||___    |
00005 |     \/    | ||      \      ||      \      ||      \      ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]-----------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00019 #include "kerneltypes.h"
00020 #include "screen.h"
00021 #include "gui.h"
00022 #include "memutil.h"
00023
00024 //---------------------------------------------------------------------------
00025 void Screen::SetManager( ScreenManager *pclScreenManager_ )
00026 {
00027     m_pclScreenManager = pclScreenManager_;
00028 }
00029
00030 //---------------------------------------------------------------------------
00031 void Screen::SetWindowAffinity( const K_CHAR *szWindowName_ )
00032 {
00033     m_pclWindow = m_pclScreenManager->FindWindowByName( szWindowName_ );
00034 }
00035
00036 //---------------------------------------------------------------------------
```

```
GuiWindow *ScreenManager::FindWindowByName( const K_CHAR *m_szName_
 )
{
    return m_pclSurface->FindWindowByName( m_szName_ );
}

//---------------------------------------------------------------------------
Screen *ScreenManager::FindScreenByName( const K_CHAR *szName_ )
{
    LinkListNode *pclTempNode = static_cast<LinkListNode*>(
m_clScreenList.GetHead());

    while (pclTempNode)
    {
        if (MemUtil::CompareStrings(szName_, static_cast<Screen*>(pclTempNode)->
GetName()))
        {
            return static_cast<Screen*>(pclTempNode);
        }
        pclTempNode = pclTempNode->GetNext();
    }

    return NULL;
}

```

14.141 /home/moslevin2/mark3/embedded/stage/src/screen.h File Reference

Higher level window management framework.

```
#include "kerneltypes.h"
#include "gui.h"
#include "ll.h"
```

Classes

- class Screen
- class ScreenList
- class ScreenManager

14.141.1 Detailed Description

Higher level window management framework.

Definition in file screen.h.

14.142 screen.h

```
/*===========================================================================
     _____     _____     _____     _____
 ___|    _|__ __|_    |__ __|__   |__ __| __  |__  ______
|    \  /  | ||    \     ||     |     ||  |/ /     ||___   |
|     \/   | ||     \    ||     \     ||     \     ||___   |
|__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
    |_____|      |_____|       |_____|       |_____|

--[Mark3 Realtime Platform]--------------------------------------------------

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===========================================================================*/
#ifndef __SCREEN_H__
#define __SCREEN_H__

#include "kerneltypes.h"
#include "gui.h"
#include "ll.h"

```

```
00026 //---------------------------------------------------------------------------
00027 class ScreenList;
00028 class ScreenManager;
00029
00030 //---------------------------------------------------------------------------
00031 class Screen : public LinkListNode
00032 {
00033 public:
00040     void Activate()             { Create(); }
00041
00047     void Deactivate()           { Destroy(); }
00048
00052     void SetWindowAffinity( const K_CHAR *szWindowName_ );
00053
00057     void SetName( const K_CHAR *szName_ )           { m_szName = szName_; }
00058
00062     const K_CHAR *GetName()                         { return m_szName; }
00063
00064 protected:
00065     friend class ScreenManager;
00066
00070     void SetManager( ScreenManager *pclScreenManager_ );
00071
00072     const K_CHAR    *m_szName;
00073     ScreenManager   *m_pclScreenManager;
00074     GuiWindow       *m_pclWindow;
00075
00076 private:
00077
00078     virtual void Create() = 0;
00079     virtual void Destroy() = 0;
00080
00081 };
00082
00083 //---------------------------------------------------------------------------
00084 class ScreenList
00085 {
00086 public:
00087     ScreenList()                        { m_clList.Init(); }
00088
00092     void Add( Screen *pclScreen_ )      { m_clList.Add(pclScreen_); }
00093
00097     void Remove( Screen *pclScreen_)    { m_clList.Remove(pclScreen_); }
00098
00102     Screen *GetHead()                   { return static_cast<Screen*>(
      m_clList.GetHead()); }
00103
00104 private:
00105     DoubleLinkList  m_clList;
00106 };
00107
00108 //---------------------------------------------------------------------------
00109 class ScreenManager
00110 {
00111 public:
00112
00113     ScreenManager() { m_pclSurface = NULL; }
00114
00118     void AddScreen( Screen *pclScreen_ )        { m_clScreenList.
      Add(pclScreen_);
00119                                                   pclScreen_->SetManager(this); }
00120
00124     void RemoveScreen( Screen *pclScreen_)      {
      m_clScreenList.Remove(pclScreen_);
00125                                                   pclScreen_->SetManager(NULL); }
00126
00130     void SetEventSurface( GuiEventSurface *pclSurface_ ) {
      m_pclSurface = pclSurface_; }
00131
00135     GuiWindow *FindWindowByName( const K_CHAR *m_szName_ );
00136
00140     Screen *FindScreenByName( const K_CHAR *m_szName_ );
00141
00142 private:
00143
00144     ScreenList m_clScreenList;
00145     GuiEventSurface *m_pclSurface;
00146 };
00147
00148 #endif
```

14.143 /home/moslevin2/mark3/embedded/stage/src/shell_support.cpp File Reference

Support functions & data structures useful in implementing a shell.

```
#include "kerneltypes.h"
#include "memutil.h"
#include "shell_support.h"
```

14.143.1 Detailed Description

Support functions & data structures useful in implementing a shell.

Definition in file shell_support.cpp.

14.144 shell_support.cpp

```
00001 /*===========================================================================
00002      _____          _____          _____          _____
00003  ___|    _|__   ___|_    |__   ___|__    |__   ___| __   |__   ______
00004 |    \  /   | ||    \       ||      |      ||  |/ /      ||___    |
00005 |     \/    | ||     \      ||      \      ||     \      ||___    |
00006 |__/\__/|__|_||__|\__\  ___||__|\__\  ___||__|\__\  ___||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00023 #include "kerneltypes.h"
00024 #include "memutil.h"
00025 #include "shell_support.h"
00026
00027 //---------------------------------------------------------------------------
00028 K_CHAR ShellSupport::RunCommand( CommandLine_t *pstCommand_, const
      ShellCommand_t *pastShellCommands_ )
00029 {
00030     K_UCHAR i = 0;
00031     K_UCHAR tmp_len;
00032     while (pastShellCommands_[i].szCommand)
00033     {
00034         tmp_len = MIN(pstCommand_->pstCommand->ucLen,
      MemUtil::StringLength(pastShellCommands_[i].szCommand));
00035
00036         if (true == MemUtil::CompareMemory( (const void*)pastShellCommands_[i].
      szCommand,
00037                                             (const void*)(pstCommand_->
      pstCommand->pcToken),
00038                                             tmp_len ) )
00039         {
00040             pastShellCommands_[i].pfHandler( pstCommand_ );
00041             return 1;
00042         }
00043         i++;
00044     }
00045     return 0;
00046 }
00047
00048 //---------------------------------------------------------------------------
00049 void ShellSupport::UnescapeToken( Token_t *pstToken_, K_CHAR *szDest_ )
00050 {
00051     const K_CHAR *szSrc = pstToken_->pcToken;
00052     int i;
00053     int j = 0;
00054     for (i = 0; i < pstToken_->ucLen; i++)
00055     {
00056         //-- Escape characters
00057         if ('\\' == szSrc[i])
00058         {
00059             i++;
00060             if (i >= pstToken_->ucLen)
00061             {
00062                 break;
00063             }
00064             switch (szSrc[i])
```

```
00065             {
00066             case 't':
00067                 szDest_[j++] = '\t';
00068                 break;
00069             case 'r':
00070                 szDest_[j++] = '\r';
00071                 break;
00072             case 'n':
00073                 szDest_[j++] = '\n';
00074                 break;
00075             case ' ':
00076                 szDest_[j++] = ' ';
00077                 break;
00078             case '\\':
00079                 szDest_[j++] = '\\';
00080                 break;
00081             case '\"':
00082                 szDest_[j++] = '\"';
00083                 break;
00084             default:
00085                 break;
00086             }
00087         }
00088         //-- Unescaped quotes
00089         else if ('\"' == szSrc[i])
00090         {
00091             continue;
00092         }
00093         //-- Everything else
00094         else
00095         {
00096             szDest_[j++] = szSrc[i];
00097         }
00098     }
00099     //-- Null-terminate the string
00100     szDest_[j] = '\0';
00101 }
00102
00103 //---------------------------------------------------------------------------
00104 Option_t *ShellSupport::CheckForOption(
      CommandLine_t *pstCommand_, const K_CHAR *szOption_ )
00105 {
00106     K_CHAR i;
00107     K_UCHAR tmp_len;
00108     for (i = 0; i < pstCommand_->ucNumOptions; i++)
00109     {
00110         tmp_len = MIN(MemUtil::StringLength(szOption_), pstCommand_->
      astOptions[i].pstStart->ucLen);
00111
00112         if (true == MemUtil::CompareMemory( (const void*)szOption_,
00113                                     (const void*)(pstCommand_->astOptions[i].
      pstStart->pcToken),
00114                                      tmp_len ) )
00115         {
00116             return &(pstCommand_->astOptions[i]);
00117         }
00118     }
00119     return 0;
00120 }
00121
00122 //---------------------------------------------------------------------------
00123 K_CHAR ShellSupport::TokensToCommandLine(
      Token_t *pastTokens_, K_UCHAR ucTokens_, CommandLine_t *pstCommand_)
00124 {
00125     K_CHAR count = 0;
00126     K_CHAR token = 0;
00127     K_CHAR option = 0;
00128     pstCommand_->ucNumOptions = 0;
00129
00130     if (!ucTokens_)
00131     {
00132         return -1;
00133     }
00134
00135     // Command is a single token...
00136     pstCommand_->pstCommand = &pastTokens_[0];
00137
00138     // Parse out options
00139     token = 1;
00140     while (token < ucTokens_ && option < 12)
00141     {
00142         pstCommand_->astOptions[option].pstStart = &pastTokens_[token];
00143         count = 1;
00144         token++;
00145         while (token < ucTokens_ && pastTokens_[token].pcToken[0] != '-')
00146         {
00147             token++;
```

```
00148             count++;
00149         }
00150         pstCommand_->astOptions[option].ucCount = count;
00151         option++;
00152     }
00153
00154     pstCommand_->ucNumOptions = option;
00155     pstCommand_->ucTokenCount = ucTokens_;
00156     pstCommand_->pastTokenList = pastTokens_;
00157     return option;
00158 }
```

14.145 /home/moslevin2/mark3/embedded/stage/src/shell_support.h File Reference

Support functions & data structures useful in implementing a shell.

```
#include "kerneltypes.h"
#include "memutil.h"
```

Classes

- struct Option_t

  Structure used to represent a command-line option with its arguments.
- struct CommandLine_t

  Structure containing multiple representations for command-line data.
- struct ShellCommand_t

  Data structure defining a lookup table correlating a command name to its handler function.
- class ShellSupport

  The ShellSupport class features utility functions which handle token processing, option/parameter lookup, and functions making it generally trivial to implement a lightweight custom shell.

Macros

- #define MIN(x, y) (((x) < (y)) ? (x) : (y))

  Utility macro used to return the lesser of two values/objects.
- #define MAX(x, y) (((x) > (y)) ? (x) : (y))

  Utility macro used to return the greater of two values/objects.

Typedefs

- typedef K_CHAR(* fp_internal_command)(CommandLine_t *pstCommandLine_)

  Function pointer type used to represent shell commands, as implemented by users of this infrastructure.

14.145.1 Detailed Description

Support functions & data structures useful in implementing a shell.

Definition in file shell_support.h.

14.145.2 Typedef Documentation

14.145.2.1 typedef K_CHAR(* fp_internal_command)(CommandLine_t *pstCommandLine_)

Function pointer type used to represent shell commands, as implemented by users of this infrastructure.

Commands return a signed 8-bit result, and take a command-line argument structure as the first and only argument.

Definition at line 110 of file shell_support.h.

14.146 shell_support.h

```
00001 /*=============================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__   ___|_    |__   ___|__   |__   ___| __   |__   ______
00004 |    \  /   | ||    \       ||      |     ||   |/ /      ||___    |
00005 |     \/    | ||     \      ||      \     ||      \      ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007    |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 =============================================================================*/
00023 #ifndef __SHELL_SUPPORT_H__
00024 #define __SHELL_SUPPORT_H__
00025
00026 //---------------------------------------------------------------------------
00027 #include "kerneltypes.h"
00028 #include "memutil.h"
00029
00030 //---------------------------------------------------------------------------
00031 #ifndef MIN
00032
00035     #define MIN(x,y)        ( ( (x) < (y) ) ? (x) : (y) )
00036 #endif
00037 #ifndef MAX
00038
00041     #define MAX(x,y)        ( ( (x) > (y) ) ? (x) : (y) )
00042 #endif
00043
00044 //---------------------------------------------------------------------------
00083 typedef struct
00084 {
00085     Token_t *pstStart;
00086     K_UCHAR ucCount;
00087 } Option_t;
00088
00089 //---------------------------------------------------------------------------
00093 typedef struct
00094 {
00095     Token_t *pastTokenList;
00096     K_UCHAR ucTokenCount;
00097
00098     Token_t *pstCommand;
00099
00100     Option_t astOptions[12];
00101     K_UCHAR ucNumOptions;
00102 } CommandLine_t;
00103
00104 //---------------------------------------------------------------------------
00110 typedef K_CHAR (*fp_internal_command)( CommandLine_t *pstCommandLine_ );
00111
00112 //---------------------------------------------------------------------------
00117 typedef struct
00118 {
00119     const K_CHAR *szCommand;
00120     fp_internal_command pfHandler;
00121 } ShellCommand_t;
00122
00123 //---------------------------------------------------------------------------
00129 class ShellSupport
00130 {
00131 public:
00132
00133     //-----------------------------------------------------------------------
00142     static K_CHAR RunCommand( CommandLine_t *pstCommand_, const
      ShellCommand_t *pastShellCommands_ );
00143
00144     //-----------------------------------------------------------------------
00155     static void UnescapeToken( Token_t *pstToken_, K_CHAR *szDest_ );
00156
00157     //-----------------------------------------------------------------------
00170     static Option_t *CheckForOption( CommandLine_t *pstCommand_, const
      K_CHAR *szOption_ );
00171
00172     //-----------------------------------------------------------------------
00183     static K_CHAR TokensToCommandLine(Token_t *pastTokens_, K_UCHAR ucTokens_,
```

```
    CommandLine_t *pstCommand_);

};



#endif // SHELL_SUPPORT_H
```

14.147 /home/moslevin2/mark3/embedded/stage/src/slip.cpp File Reference

Serial Line IP framing code.

```
#include "kerneltypes.h"
#include "slip.h"
#include "driver.h"
```

Macros

- #define FRAMING_BYTE (192)

  Byte indicating end-of-frame.
- #define FRAMING_ENC_BYTE (219)

  Byte used to indicate substitution.
- #define FRAMING_SUB_BYTE (220)

  Byte to substitute for framing byte.
- #define FRAMING_SUB_ENC_BYTE (221)

  Byte to substitute for the substitute-byte.
- #define ACchar (69)

  Acknowledgement character.
- #define NACchar (96)

  Non-acknowledgement character.

14.147.1 Detailed Description

Serial Line IP framing code.

Definition in file slip.cpp.

14.148 slip.cpp

```
/*===========================================================================
     _____     _____     _____     _____
 ___|    _|__ __|_    |__ __|__   |__ __| __  |__  _____
|    \  /  | ||    \    ||     |     ||  |/ /    ||___   |
|     \/   | ||     \   ||     \     ||     \    ||___   |
|__/\__/|__|_||__|\__\ __||__|\__\ __||__|\__\ __||_____|
    |_____|      |_____|      |_____|      |_____|

--[Mark3 Realtime Platform]--------------------------------------------------

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===========================================================================*/
#include "kerneltypes.h"
#include "slip.h"
#include "driver.h"

//---------------------------------------------------------------------------
#define FRAMING_BYTE            (192)
#define FRAMING_ENC_BYTE        (219)
#define FRAMING_SUB_BYTE        (220)
#define FRAMING_SUB_ENC_BYTE    (221)
```

```
00028
00029 //-----------------------------------------------------------------------------
00030 #define ACchar                (69)
00031 #define NACchar               (96)
00032
00033 //-----------------------------------------------------------------------------
00034 K_USHORT Slip::EncodeByte( K_UCHAR ucChar_, K_UCHAR *aucBuf_ )
00035 {
00036     K_USHORT usLen = 1;
00037     switch (ucChar_)
00038     {
00039         case FRAMING_BYTE:
00040             aucBuf_[0] = FRAMING_ENC_BYTE;
00041             aucBuf_[1] = FRAMING_SUB_BYTE;
00042             usLen = 2;
00043             break;
00044         case FRAMING_ENC_BYTE:
00045             aucBuf_[0] = FRAMING_ENC_BYTE;
00046             aucBuf_[1] = FRAMING_SUB_ENC_BYTE;
00047             usLen = 2;
00048             break;
00049         default:
00050             aucBuf_[0] = ucChar_;
00051     }
00052     return usLen;
00053 }
00054
00055 //-----------------------------------------------------------------------------
00056 K_USHORT Slip::DecodeByte( K_UCHAR *ucChar_, const K_UCHAR *aucBuf_ )
00057 {
00058     K_USHORT usLen = 1;
00059
00060     if (aucBuf_[0] == FRAMING_ENC_BYTE)
00061     {
00062         if(aucBuf_[1] == FRAMING_SUB_BYTE)
00063         {
00064             *ucChar_ = FRAMING_BYTE;
00065             usLen = 2;
00066         }
00067         else if(aucBuf_[1] == FRAMING_SUB_ENC_BYTE)
00068         {
00069             *ucChar_ = FRAMING_ENC_BYTE;
00070             usLen = 2;
00071         }
00072         else
00073         {
00074             *ucChar_ = 0;
00075             usLen = 0;
00076         }
00077     }
00078     else if (aucBuf_[0] == FRAMING_BYTE)
00079     {
00080         usLen = 0;
00081         *ucChar_ = 0;
00082     }
00083     else
00084     {
00085         *ucChar_ = aucBuf_[0];
00086     }
00087     return usLen;
00088 }
00089
00090 //-----------------------------------------------------------------------------
00091 void Slip::WriteByte( K_UCHAR ucData_)
00092 {
00093     K_USHORT usSize = 0;
00094     K_USHORT usIdx = 0;
00095     K_UCHAR aucBuf[2];
00096     usSize = EncodeByte(ucData_, aucBuf);
00097     while (usIdx < usSize)
00098     {
00099         usIdx += m_pclDriver->Write(usSize, &aucBuf[usIdx]);
00100     }
00101 }
00102
00103 //-----------------------------------------------------------------------------
00104 K_USHORT Slip::ReadData(K_UCHAR *pucChannel_, K_CHAR *aucBuf_, K_USHORT usLen_)
00105 {
00106     K_USHORT usReadCount;
00107     K_UCHAR ucTempCount;
00108     K_USHORT usValid = 0;
00109     K_USHORT usCRC;
00110     K_USHORT usCRC_Calc = 0;
00111     K_USHORT usLen;
00112     K_UCHAR *pucSrc = (K_UCHAR*)aucBuf_;
00113     K_UCHAR *pucDst = (K_UCHAR*)aucBuf_;
00114
```

```
00115     usReadCount = m_pclDriver->Read(usLen_, (K_UCHAR*)aucBuf_);
00116
00117     while (usReadCount)
00118     {
00119         K_UCHAR ucRead;
00120         ucTempCount = DecodeByte(&ucRead, pucSrc);
00121
00122         *pucDst = ucRead;
00123
00124         // Encountered a FRAMING_BYTE - end of message
00125         if (!ucTempCount)
00126         {
00127             break;
00128         }
00129
00130         // Add to the CRC
00131         usCRC_Calc += ucRead;
00132
00133         // Adjust iterators, source, and destination pointers.
00134         usReadCount -= ucTempCount;
00135         pucSrc += ucTempCount;
00136         pucDst++;
00137         usValid++;
00138     }
00139
00140     // Ensure we have enough data to try a match.
00141     if (usValid < 5) {
00142         return 0;
00143     }
00144
00145     usCRC_Calc -= aucBuf_[usValid-2];
00146     usCRC_Calc -= aucBuf_[usValid-1];
00147
00148     usLen = ((K_USHORT)aucBuf_[1]) << 8;
00149     usLen += ((K_USHORT)aucBuf_[2]);
00150     usCRC = ((K_USHORT)aucBuf_[usValid-2]) << 8;
00151     usCRC += ((K_USHORT)aucBuf_[usValid-1]);
00152
00153     if (usCRC != usCRC_Calc)
00154     {
00155         return 0;
00156     }
00157
00158     *pucChannel_ = aucBuf_[0];
00159
00160     return usLen;
00161 }
00162
00163 //---------------------------------------------------------------------------
00164 void Slip::WriteData(K_UCHAR ucChannel_, const K_CHAR *aucBuf_, K_USHORT usLen_)
00165 {
00166     K_UCHAR aucTmp[2];
00167     K_USHORT usCRC = 0;
00168
00169     // Lightweight protocol built on-top of SLIP.
00170     // 1) Channel ID (8-bit)
00171     // 2) Data Size (16-bit)
00172     // 3) Data blob
00173     // 4) CRC16 (16-bit)
00174     aucTmp[0] = FRAMING_BYTE;
00175     while( !m_pclDriver->Write(1, aucTmp) ) {}
00176
00177     if (!usLen_)    // Read to end-of-line (\0)
00178     {
00179         K_UCHAR *pucBuf = (K_UCHAR*)aucBuf_;
00180         while (*pucBuf != '\0')
00181         {
00182             usLen_++;
00183             pucBuf++;
00184         }
00185     }
00186
00187     WriteByte(ucChannel_);
00188     usCRC = ucChannel_;
00189
00190     WriteByte((K_UCHAR)(usLen_ >> 8));
00191     usCRC += (usLen_ >> 8);
00192
00193     WriteByte((K_UCHAR)(usLen_ & 0x00FF));
00194     usCRC += (usLen_ & 0x00FF);
00195
00196     while (usLen_--)
00197     {
00198         WriteByte(*aucBuf_);
00199         usCRC += (K_USHORT)*aucBuf_;
00200         aucBuf_++;
00201     }
```

```
00202
00203     WriteByte((K_UCHAR)(usCRC >> 8));
00204     WriteByte((K_UCHAR)(usCRC & 0x00FF));
00205
00206     aucTmp[0] = FRAMING_BYTE;
00207     while( !m_pclDriver->Write(1, aucTmp) ) {}
00208 }
00209
00210 //---------------------------------------------------------------------------
00211 void Slip::SendAck()
00212 {
00213     WriteByte(ACchar);
00214 }
00215
00216 //---------------------------------------------------------------------------
00217 void Slip::SendNack()
00218 {
00219     WriteByte(NACchar);
00220 }
00221
00222 //---------------------------------------------------------------------------
00223 void Slip::WriteVector(K_UCHAR ucChannel_, SlipDataVector *astData_,
      K_USHORT usLen_)
00224 {
00225     K_UCHAR aucTmp[2];
00226     K_USHORT usCRC = 0;
00227     K_UCHAR i, j;
00228     K_USHORT usTotalLen = 0;
00229
00230     // Calculate the total length of all message fragments
00231     for (i = 0; i < usLen_; i++)
00232     {
00233         usTotalLen += astData_[i].ucSize;
00234     }
00235
00236     // Send a FRAMING_BYTE to start framing a message
00237     aucTmp[0] = FRAMING_BYTE;
00238     while( !m_pclDriver->Write(1, aucTmp) ) {}
00239
00240     // Write a the channel
00241     WriteByte(ucChannel_);
00242     usCRC = ucChannel_;
00243
00244     // Write the length
00245     WriteByte((K_UCHAR)(usTotalLen >> 8));
00246     usCRC += (usTotalLen >> 8);
00247
00248     WriteByte((K_UCHAR)(usTotalLen & 0x00FF));
00249     usCRC += (usTotalLen & 0x00FF);
00250
00251     // Write the message fragments
00252     for (i = 0; i < usLen_; i++)
00253     {
00254         K_UCHAR *aucBuf = astData_[i].pucData;
00255         for (j = 0; j < astData_[i].ucSize; j++ )
00256         {
00257             WriteByte(*aucBuf);
00258             usCRC += (K_USHORT)*aucBuf;
00259             aucBuf++;
00260         }
00261     }
00262
00263     // Write the CRC
00264     WriteByte((K_UCHAR)(usCRC >> 8));
00265     WriteByte((K_UCHAR)(usCRC & 0x00FF));
00266
00267     // Write the end-of-message
00268     aucTmp[0] = FRAMING_BYTE;
00269     while( !m_pclDriver->Write(1, aucTmp) ) {}
00270 }
```

14.149 /home/moslevin2/mark3/embedded/stage/src/slip.h File Reference

Serial Line IP framing code.

```
#include "kerneltypes.h"
#include "driver.h"
```

Classes

- struct SlipDataVector

  Data structure used for vector-based SLIP data transmission.
- class Slip

  Object used to frame communications over an abstract device using the serial-line internet protocol (SLIP).

Enumerations

- enum SlipChannel {
  SLIP_CHANNEL_TERMINAL = 0, SLIP_CHANNEL_UNISCOPE, SLIP_CHANNEL_NVM, SLIP_CHANNEL-
  _RESET,
  SLIP_CHANNEL_GRAPHICS, SLIP_CHANNEL_HID, **SLIP_CHANNEL_COUNT** }

14.149.1 Detailed Description

Serial Line IP framing code. Also includes code to frame data in FunkenSlip format for use with SlipTerm on a host PC.

FunkenSlip uses SLIP-framed messages with a pre-defined packet format as follows:

[Channel][Size][Data Buffer][CRC8]

Channel is 1 byte, indicating the type of data carried in the message

Size is 2 bytes, indicating the length of the binary blob that follows

Data Buffer is n bytes, and contains the raw packet data.

CRC16 is 2 byte, Providing an error detection mechanism

Definition in file slip.h.

14.149.2 Enumeration Type Documentation

14.149.2.1 enum SlipChannel

Enumerator

SLIP_CHANNEL_TERMINAL ASCII text mode terminal.

SLIP_CHANNEL_UNISCOPE Uniscope VM command channel.

SLIP_CHANNEL_NVM Non-volatile memory configuration.

SLIP_CHANNEL_RESET Channel used to reset the device...

SLIP_CHANNEL_GRAPHICS Encoded drawing commands.

SLIP_CHANNEL_HID HID commands.

Definition at line 41 of file slip.h.

14.150 slip.h

```
00001 /*=========================================================================
00002     _____          _____          _____          _____
00003  ___|    _|__   __|_    |__   __|__   |__   __| __   |__  _______
00004 |    \  /  | ||    \       ||      |      ||  |/ /      ||___    |
00005 |     \/   | ||     \      ||      \      ||     \      ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||_______|
00007    |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
```

```
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00034 #include "kerneltypes.h"
00035 #include "driver.h"
00036
00037 #ifndef __SLIP_H__
00038 #define __SLIP_H__
00039
00040 //---------------------------------------------------------------------------
00041 typedef enum
00042 {
00043     SLIP_CHANNEL_TERMINAL = 0,
00044     SLIP_CHANNEL_UNISCOPE,
00045     SLIP_CHANNEL_NVM,
00046     SLIP_CHANNEL_RESET,
00047     SLIP_CHANNEL_GRAPHICS,
00048     SLIP_CHANNEL_HID,
00049 //---
00050     SLIP_CHANNEL_COUNT
00051 } SlipChannel;
00052
00053 //---------------------------------------------------------------------------
00059 typedef struct
00060 {
00061     K_UCHAR ucSize;
00062     K_UCHAR *pucData;
00063 }SlipDataVector;
00064
00065 //---------------------------------------------------------------------------
00070 class Slip
00071 {
00072 public:
00078     void SetDriver( Driver *pclDriver_ ){ m_pclDriver = pclDriver_; }
00079
00085     Driver *GetDriver() { return m_pclDriver; }
00086
00098     static K_USHORT EncodeByte( K_UCHAR ucChar_, K_UCHAR *aucBuf_ );
00099
00114     static K_USHORT DecodeByte( K_UCHAR *ucChar_, const K_UCHAR *aucBuf_ );
00115
00128     void WriteData( K_UCHAR ucChannel_, const K_CHAR *aucBuf_, K_USHORT usLen_ );
00129
00142     K_USHORT ReadData( K_UCHAR *pucChannel_, K_CHAR *aucBuf_, K_USHORT usLen_ );
00143
00156     void WriteVector( K_UCHAR ucChannel_, SlipDataVector *astData_, K_USHORT
    usLen_ );
00157
00163     void SendAck();
00164
00170     void SendNack();
00171
00172 private:
00173     void WriteByte(K_UCHAR ucData_);
00174     Driver *m_pclDriver;
00175 };
00176
00177 #endif
```

14.151 /home/moslevin2/mark3/embedded/stage/src/slip_mux.cpp File Reference

FunkenSlip Channel Multiplexer.

```
#include "kerneltypes.h"
#include "driver.h"
#include "drvUART.h"
#include "slip.h"
#include "slip_mux.h"
#include "message.h"
```

Functions

- static void SlipMux_CallBack (Driver *pclDriver_)

14.151.1 Detailed Description

FunkenSlip Channel Multiplexer. Demultiplexes FunkenSlip packets transmitted over a single serial channel, and provides an abstraction to attach handlers for each event type.

Definition in file slip_mux.cpp.

14.151.2 Function Documentation

14.151.2.1 static void SlipMux_CallBack (Driver * *pclDriver_*) [static]

Parameters

*pclDriver_*	Pointer to the driver data for the port triggering the callback

Definition at line 43 of file slip_mux.cpp.

14.152 slip_mux.cpp

```
00001 /*===========================================================================
00002      _____          _____          _____          _____
00003  ___|    _|__   ___|_    |__   ___|__    |__   ___| __   |__   ______
00004 |    \  /  | ||    \       ||      |     ||  |/ /     ||___    |
00005 |     \/   | ||     \      ||      \     ||     \     ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00022 #include "kerneltypes.h"
00023 #include "driver.h"
00024 #include "drvUART.h"
00025 #include "slip.h"
00026 #include "slip_mux.h"
00027 #include "message.h"
00028
00029 //---------------------------------------------------------------------------
00030 MessageQueue *SlipMux::m_pclMessageQueue;
00031 K_UCHAR SlipMux::m_aucData[SLIP_BUFFER_SIZE];
00032 Driver *SlipMux::m_pclDriver;
00033 Slip_Channel SlipMux::m_apfChannelHandlers[SLIP_CHANNEL_COUNT] = {0};
00034 Semaphore SlipMux::m_clSlipSem;
00035 Slip SlipMux::m_clSlip;
00036
00037 //---------------------------------------------------------------------------
00043 static void SlipMux_CallBack( Driver *pclDriver_)
00044 {
00045     Message *pclMsg = GlobalMessagePool::Pop();
00046     if (pclMsg)
00047     {
00048         pclDriver_->Control(CMD_SET_RX_DISABLE, 0, 0, 0, 0);
00049
00050         // Send a message to the queue, letting it know that there's a
00051         // pending slip message that needs to be processed
00052         pclMsg->SetCode(SLIP_RX_MESSAGE_ID);
00053         pclMsg->SetData(NULL);
00054         SlipMux::GetQueue()->Send(pclMsg);
00055     }
00056 }
00057
00058 //---------------------------------------------------------------------------
00059 void SlipMux::Init(const K_CHAR *pcDriverPath_, K_USHORT usRxSize_, K_UCHAR *aucRx_, K_USHORT
      usTxSize_, K_UCHAR *aucTx_)
00060 {
00061     m_pclDriver = DriverList::FindByPath(pcDriverPath_);
00062     m_pclMessageQueue = NULL;
00063
00064     m_clSlip.SetDriver(m_pclDriver);
00065     m_clSlipSem.Init(0, 1);
00066
00067     m_pclDriver->Control(CMD_SET_BUFFERS, (void*)aucRx_, usRxSize_, (void*)aucTx_, usTxSize_);
00068     m_pclDriver->Control(CMD_SET_RX_CALLBACK, (void*)SlipMux_CallBack, 0, 0, 0);
00069     {
```

```
00070         K_UCHAR ucEscape = 192;
00071         m_pclDriver->Control(CMD_SET_RX_ESCAPE, (void*)&ucEscape, 1, 0, NULL);
00072     }
00073 }
00074
00075 //---------------------------------------------------------------------------
00076 void SlipMux::InstallHandler( K_UCHAR ucChannel_, Slip_Channel pfHandler_ )
00077 {
00078     if (pfHandler_)
00079     {
00080         m_apfChannelHandlers[ucChannel_] = pfHandler_;
00081     }
00082 }
00083
00084 //---------------------------------------------------------------------------
00085 void SlipMux::MessageReceive(void)
00086 {
00087     K_USHORT usLen;
00088     K_UCHAR ucChannel;
00089
00090     usLen = m_clSlip.ReadData( &ucChannel, (K_CHAR*)m_aucData, SLIP_BUFFER_SIZE );
00091     if (usLen && (m_apfChannelHandlers[ucChannel] != NULL))
00092     {
00093         m_apfChannelHandlers[ucChannel]( m_pclDriver, ucChannel, &(m_aucData[3]), usLen);
00094     }
00095
00096     // Re-enable the driver once we're done.
00097     m_pclDriver->Control( CMD_SET_RX_ENABLE, 0, 0, 0, 0 );
00098 }
00099
```

14.153 /home/moslevin2/mark3/embedded/stage/src/slip_mux.h File Reference

FunkenSlip Channel Multiplexer.

```
#include "kerneltypes.h"
#include "driver.h"
#include "ksemaphore.h"
#include "message.h"
#include "slip.h"
```

Classes

- class SlipMux

  Static-class which implements a multiplexed stream of SLIP data over a single interface.

Macros

- #define **SLIP_BUFFER_SIZE** (32)
- #define **SLIP_RX_MESSAGE_ID** (0xD00D)

Typedefs

- typedef void(* **Slip_Channel**)(Driver *pclDriver_, K_UCHAR ucChannel_, K_UCHAR *pucData_, K_USHORT usLen_)

14.153.1 Detailed Description

FunkenSlip Channel Multiplexer. Demultiplexes FunkenSlip packets transmitted over a single serial channel

Definition in file slip_mux.h.

14.154 slip_mux.h

```
/*===========================================================================
     _____     _____     _____     _____
 ___|    _|__ __|_    |__ __|__   |__ __| __  |__ _____
|    \  /  | ||    \    ||     |     ||  |/ /    ||___   |
|     \/   | ||     \   ||     \     ||     \    ||___   |
|__/\__/|__|_||__|\__\ __||__|\__\ __||__|\__\ __||______|
    |_____|      |_____|      |_____|      |_____|

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===========================================================================*/
#include "kerneltypes.h"
#include "driver.h"
#include "ksemaphore.h"
#include "message.h"
#include "slip.h"

#ifndef __SLIP_MUX_H__
#define __SLIP_MUX_H__

//---------------------------------------------------------------------------
#define SLIP_BUFFER_SIZE    (32)

#define SLIP_RX_MESSAGE_ID  (0xD00D)

//---------------------------------------------------------------------------
typedef void (*Slip_Channel)( Driver *pclDriver_, K_UCHAR ucChannel_, K_UCHAR *pucData_, K_USHORT
usLen_ );

//---------------------------------------------------------------------------
class SlipMux
{
public:
    static void Init(const K_CHAR *pcDriverPath_, K_USHORT usRxSize_, K_UCHAR *aucRx_, K_USHORT
usTxSize_, K_UCHAR *aucTx_);

    static void InstallHandler( K_UCHAR ucChannel_, Slip_Channel pfHandler_ );

    static void MessageReceive();

    static Driver *GetDriver(){ return m_pclDriver; }

    static MessageQueue *GetQueue(){ return m_pclMessageQueue; }

    static void SetQueue( MessageQueue *pclMessageQueue_ )
        { m_pclMessageQueue = pclMessageQueue_; }


    static Slip *GetSlip(){ return &m_clSlip; }

private:
    static MessageQueue *m_pclMessageQueue;
    static Driver *m_pclDriver;
    static Slip_Channel m_apfChannelHandlers[SLIP_CHANNEL_COUNT];
    static K_UCHAR m_aucData[SLIP_BUFFER_SIZE];
    static Semaphore m_clSlipSem;
    static Slip m_clSlip;
};

#endif
```

14.155 /home/moslevin2/mark3/embedded/stage/src/slipterm.cpp File Reference

Serial debug interface using SLIP protocol, and FunkenSlip multiplexing.

```
#include "kerneltypes.h"
#include "slip.h"
#include "slipterm.h"
```

14.155.1 Detailed Description

Serial debug interface using SLIP protocol, and FunkenSlip multiplexing.

Definition in file slipterm.cpp.

14.156 slipterm.cpp

```
/*===========================================================================
     _____     _____     _____     _____
 ___|    _|__ __|_    |__ __|__   |__ __| __  |__  ______
|    \  /  | ||    \    ||     |     ||  |/ /    ||___   |
|     \/   | ||     \   ||     \     ||     \    ||___   |
|__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
    |_____|      |_____|      |_____|      |_____|

--[Mark3 Realtime Platform]--------------------------------------------------

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===========================================================================*/
#include "kerneltypes.h"
#include "slip.h"
#include "slipterm.h"

//---------------------------------------------------------------------------
void SlipTerm::Init()
{
    m_clSlip.SetDriver( DriverList::FindByPath("/dev/tty" ) );
    m_ucVerbosity = SEVERITY_DEBUG;
}

//---------------------------------------------------------------------------
K_USHORT SlipTerm::StrLen( const char *szLine_ )
{
    K_USHORT i=0;
    while (szLine_[i] != 0 )
    {
        i++;
    }
    return i;
}

//---------------------------------------------------------------------------
void SlipTerm::PrintLn( const char *szLine_ )
{
    SlipDataVector astData[2];
    astData[0].pucData = (K_UCHAR*)szLine_;
    astData[0].ucSize = StrLen(szLine_);
    astData[1].pucData = (K_UCHAR*)"\r\n";
    astData[1].ucSize = 2;

    m_clSlip.WriteVector(SLIP_CHANNEL_TERMINAL, astData, 2);
}

//---------------------------------------------------------------------------
void SlipTerm::PrintLn( K_UCHAR ucSeverity_, const char *szLine_ )
{
    if (ucSeverity_ <= m_ucVerbosity)
    {
        PrintLn( szLine_ );
    }
}
```

14.157 /home/moslevin2/mark3/embedded/stage/src/slipterm.h File Reference

Serial debug interface using SLIP serial, and Funkenslip serial port multiplexing.

```
#include "kerneltypes.h"
#include "driver.h"
#include "slip.h"
```

Classes

- class SlipTerm

  Class implementing a simple debug terminal interface.

Macros

- #define **SEVERITY_DEBUG** 4
- #define **SEVERITY_INFO** 3
- #define **SEVERITY_WARN** 2
- #define **SEVERITY_CRITICAL** 1
- #define **SEVERITY_CATASTROPHIC** 0
- #define **__SLIPTERM_H__**

14.157.1 Detailed Description

Serial debug interface using SLIP serial, and Funkenslip serial port multiplexing.

Definition in file slipterm.h.

14.158 slipterm.h

```
00001 /*=========================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__   ____|_    |__   ____|__    |__   __| __   |__   _______
00004 |    \   /  | ||    \       ||      |     ||   |/ /     ||___    |
00005 |     \/    | ||     \      ||      \     ||     \      ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||_______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 =========================================================================*/
00021 #include "kerneltypes.h"
00022 #include "driver.h"
00023 #include "slip.h"
00024
00025 //---------------------------------------------------------------------------
00026 #define SEVERITY_DEBUG              4
00027 #define SEVERITY_INFO               3
00028 #define SEVERITY_WARN               2
00029 #define SEVERITY_CRITICAL           1
00030 #define SEVERITY_CATASTROPHIC       0
00031
00032 //---------------------------------------------------------------------------
00033 #ifndef __SLIPTERM_H__
00034 #define __SLIPTERM_H__
00035
00040 class SlipTerm
00041 {
00042 public:
00050     void Init();
00051
00060     void PrintLn( const char *szLine_ );
00061
00072     void PrintLn( K_UCHAR ucSeverity_, const char *szLine_ );
00073
00081     void SetVerbosity( K_UCHAR ucLevel_ ) { m_ucVerbosity = ucLevel_; }
00082 private:
00090     K_USHORT StrLen( const char *szString_ );
00091
00092     K_UCHAR m_ucVerbosity;
00093
00094
00095     Slip m_clSlip;
00096 };
00097
00098 #endif
```

14.159 /home/moslevin2/mark3/embedded/stage/src/system_heap.cpp File Reference

Global system-heap implementation.

```
#include "kerneltypes.h"
#include "system_heap_config.h"
#include "system_heap.h"
```

14.159.1 Detailed Description

Global system-heap implementation. Provides a system-wide malloc/free paradigm allocation scheme.

Definition in file system_heap.cpp.

14.160 system_heap.cpp

```
00001 /*=========================================================================
00002      _____          _____          _____          _____
00003  ___|    _|__   __|_    |__   __|__    |__   __| __   |__  ______
00004 |    \  /  | ||    \       ||      |     ||  |/ /     ||___   |
00005 |     \/   | ||     \      ||      \     ||     \     ||___   |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 =========================================================================*/
00021 #include "kerneltypes.h"
00022 #include "system_heap_config.h"
00023 #include "system_heap.h"
00024
00025 #if USE_SYSTEM_HEAP
00026
00027 //---------------------------------------------------------------------------
00028 K_UCHAR    SystemHeap::m_pucRawHeap[ HEAP_RAW_SIZE ];
00029 HeapConfig SystemHeap::m_pclSystemHeapConfig[
      HEAP_NUM_SIZES + 1];
00030 FixedHeap  SystemHeap::m_clSystemHeap;
00031 bool       SystemHeap::m_bInit;
00032
00033 //---------------------------------------------------------------------------
00034 void SystemHeap::Init(void)
00035 {
00036 #if HEAP_NUM_SIZES > 0
00037     m_pclSystemHeapConfig[0].m_usBlockSize  =
      HEAP_BLOCK_SIZE_1;
00038     m_pclSystemHeapConfig[0].m_usBlockCount =
      HEAP_BLOCK_COUNT_1;
00039 #endif
00040 #if HEAP_NUM_SIZES > 1
00041     m_pclSystemHeapConfig[1].m_usBlockSize  = HEAP_BLOCK_SIZE_2;
00042     m_pclSystemHeapConfig[1].m_usBlockCount = HEAP_BLOCK_COUNT_2;
00043 #endif
00044 #if HEAP_NUM_SIZES > 2
00045     m_pclSystemHeapConfig[2].m_usBlockSize  = HEAP_BLOCK_SIZE_3;
00046     m_pclSystemHeapConfig[2].m_usBlockCount = HEAP_BLOCK_COUNT_3;
00047 #endif
00048 #if HEAP_NUM_SIZES > 3
00049     m_pclSystemHeapConfig[3].m_usBlockSize  = HEAP_BLOCK_SIZE_4;
00050     m_pclSystemHeapConfig[3].m_usBlockCount = HEAP_BLOCK_COUNT_4;
00051 #endif
00052 #if HEAP_NUM_SIZES > 4
00053     m_pclSystemHeapConfig[4].m_usBlockSize  = HEAP_BLOCK_SIZE_5;
00054     m_pclSystemHeapConfig[4].m_usBlockCount = HEAP_BLOCK_COUNT_5;
00055 #endif
00056 #if HEAP_NUM_SIZES > 5
00057     m_pclSystemHeapConfig[5].m_usBlockSize  = HEAP_BLOCK_SIZE_6;
00058     m_pclSystemHeapConfig[5].m_usBlockCount = HEAP_BLOCK_COUNT_6;
00059 #endif
00060 #if HEAP_NUM_SIZES > 6
00061     m_pclSystemHeapConfig[6].m_usBlockSize  = HEAP_BLOCK_SIZE_7;
00062     m_pclSystemHeapConfig[6].m_usBlockCount = HEAP_BLOCK_COUNT_7;
00063 #endif
00064 #if HEAP_NUM_SIZES > 7
00065     m_pclSystemHeapConfig[7].m_usBlockSize  = HEAP_BLOCK_SIZE_8;
00066     m_pclSystemHeapConfig[7].m_usBlockCount = HEAP_BLOCK_COUNT_8;
00067 #endif
00068 #if HEAP_NUM_SIZES > 8
00069     m_pclSystemHeapConfig[8].m_usBlockSize  = HEAP_BLOCK_SIZE_9;
```

```
00070     m_pclSystemHeapConfig[8].m_usBlockCount = HEAP_BLOCK_COUNT_9;
00071 #endif
00072 #if HEAP_NUM_SIZES > 9
00073     m_pclSystemHeapConfig[9].m_usBlockSize  = HEAP_BLOCK_SIZE_10;
00074     m_pclSystemHeapConfig[9].m_usBlockCount = HEAP_BLOCK_COUNT_10;
00075 #endif
00076 #if HEAP_NUM_SIZES > 10
00077     m_pclSystemHeapConfig[10].m_usBlockSize  = HEAP_BLOCK_SIZE_11;
00078     m_pclSystemHeapConfig[10].m_usBlockCount = HEAP_BLOCK_COUNT_11;
00079 #endif
00080 #if HEAP_NUM_SIZES > 11
00081     m_pclSystemHeapConfig[11].m_usBlockSize  = HEAP_BLOCK_SIZE_12;
00082     m_pclSystemHeapConfig[11].m_usBlockCount = HEAP_BLOCK_COUNT_12;
00083 #endif
00084 #if HEAP_NUM_SIZES > 12
00085     m_pclSystemHeapConfig[12].m_usBlockSize  = HEAP_BLOCK_SIZE_13;
00086     m_pclSystemHeapConfig[12].m_usBlockCount = HEAP_BLOCK_COUNT_13;
00087 #endif
00088 #if HEAP_NUM_SIZES > 13
00089     m_pclSystemHeapConfig[13].m_usBlockSize  = HEAP_BLOCK_SIZE_14;
00090     m_pclSystemHeapConfig[13].m_usBlockCount = HEAP_BLOCK_COUNT_14;
00091 #endif
00092 #if HEAP_NUM_SIZES > 14
00093     m_pclSystemHeapConfig[14].m_usBlockSize  = HEAP_BLOCK_SIZE_15;
00094     m_pclSystemHeapConfig[14].m_usBlockCount = HEAP_BLOCK_COUNT_15;
00095 #endif
00096 #if HEAP_NUM_SIZES > 15
00097     m_pclSystemHeapConfig[15].m_usBlockSize  = HEAP_BLOCK_SIZE_16;
00098     m_pclSystemHeapConfig[15].m_usBlockCount = HEAP_BLOCK_COUNT_16;
00099 #endif
00100 #if HEAP_NUM_SIZES > 16
00101     m_pclSystemHeapConfig[16].m_usBlockSize  = HEAP_BLOCK_SIZE_17;
00102     m_pclSystemHeapConfig[16].m_usBlockCount = HEAP_BLOCK_COUNT_17;
00103 #endif
00104 #if HEAP_NUM_SIZES > 17
00105     m_pclSystemHeapConfig[17].m_usBlockSize  = HEAP_BLOCK_SIZE_18;
00106     m_pclSystemHeapConfig[17].m_usBlockCount = HEAP_BLOCK_COUNT_18;
00107 #endif
00108 #if HEAP_NUM_SIZES > 18
00109     m_pclSystemHeapConfig[18].m_usBlockSize  = HEAP_BLOCK_SIZE_19;
00110     m_pclSystemHeapConfig[18].m_usBlockCount = HEAP_BLOCK_COUNT_19;
00111 #endif
00112 #if HEAP_NUM_SIZES > 19
00113     m_pclSystemHeapConfig[19].m_usBlockSize  = HEAP_BLOCK_SIZE_20;
00114     m_pclSystemHeapConfig[19].m_usBlockCount = HEAP_BLOCK_COUNT_20;
00115 #endif
00116 #if HEAP_NUM_SIZES > 20
00117     m_pclSystemHeapConfig[20].m_usBlockSize  = HEAP_BLOCK_SIZE_21;
00118     m_pclSystemHeapConfig[20].m_usBlockCount = HEAP_BLOCK_COUNT_21;
00119 #endif
00120
00121     m_pclSystemHeapConfig[HEAP_NUM_SIZES].
    m_usBlockSize = 0;
00122     m_pclSystemHeapConfig[HEAP_NUM_SIZES].
    m_usBlockCount = 0;
00123
00124     m_clSystemHeap.Create((void*)m_pucRawHeap,
    m_pclSystemHeapConfig);
00125
00126     m_bInit = true;
00127 }
00128
00129 //---------------------------------------------------------------------------
00130 void *SystemHeap::Alloc(K_USHORT usSize_)
00131 {
00132     if (!m_bInit)
00133     {
00134         return NULL;
00135     }
00136     return m_clSystemHeap.Alloc(usSize_);
00137 }
00138
00139 //---------------------------------------------------------------------------
00140 void SystemHeap::Free(void* pvBlock_)
00141 {
00142     if (!m_bInit)
00143     {
00144         return;
00145     }
00146     m_clSystemHeap.Free(pvBlock_);
00147 }
00148
00149 #endif // USE_SYSTEM_HEAP
```

14.161 /home/moslevin2/mark3/embedded/stage/src/system_heap.h File Reference

Global system-heap implmentation.

```
#include "system_heap_config.h"
#include "fixed_heap.h"
```

Classes

- class SystemHeap

  The SystemHeap class implements a heap which is accessible from all components in the system.

Macros

- #define HEAP_RAW_SIZE_1 ((HEAP_BLOCK_SIZE_1 + sizeof(LinkListNode) + sizeof(void*)) * HEAP_BLOCK_COUNT_1)

  Really ugly computations used to auto-size the heap footprint based on the user-configuration data.
- #define **HEAP_RAW_SIZE_2** ((HEAP_BLOCK_SIZE_2 + sizeof(LinkListNode) + sizeof(void*)) * HEAP_BLOCK_COUNT_2)
- #define **HEAP_RAW_SIZE_3** ((HEAP_BLOCK_SIZE_3 + sizeof(LinkListNode) + sizeof(void*)) * HEAP_BLOCK_COUNT_3)
- #define **HEAP_RAW_SIZE_4** 0
- #define **HEAP_RAW_SIZE_5** 0
- #define **HEAP_RAW_SIZE_6** 0
- #define **HEAP_RAW_SIZE_7** 0
- #define **HEAP_RAW_SIZE_8** 0
- #define **HEAP_RAW_SIZE_9** 0
- #define **HEAP_RAW_SIZE_10** 0
- #define **HEAP_RAW_SIZE_11** 0
- #define **HEAP_RAW_SIZE_12** 0
- #define **HEAP_RAW_SIZE_13** 0
- #define **HEAP_RAW_SIZE_14** 0
- #define **HEAP_RAW_SIZE_15** 0
- #define **HEAP_RAW_SIZE_16** 0
- #define **HEAP_RAW_SIZE_17** 0
- #define **HEAP_RAW_SIZE_18** 0
- #define **HEAP_RAW_SIZE_19** 0
- #define **HEAP_RAW_SIZE_20** 0
- #define **HEAP_RAW_SIZE_21** 0
- #define **HEAP_RAW_SIZE**

14.161.1 Detailed Description

Global system-heap implmentation. Provides a basic malloc()/free() allocation scheme.

Definition in file system_heap.h.

14.161.2 Macro Definition Documentation

14.161.2.1 #define HEAP_RAW_SIZE

Value:

```
HEAP_RAW_SIZE_1 + \
HEAP_RAW_SIZE_2 + \
HEAP_RAW_SIZE_3 + \
HEAP_RAW_SIZE_4 + \
HEAP_RAW_SIZE_5 + \
HEAP_RAW_SIZE_6 + \
HEAP_RAW_SIZE_7 + \
HEAP_RAW_SIZE_8 + \
HEAP_RAW_SIZE_9 + \
HEAP_RAW_SIZE_10 + \
HEAP_RAW_SIZE_11 + \
HEAP_RAW_SIZE_12 + \
HEAP_RAW_SIZE_13 + \
HEAP_RAW_SIZE_14 + \
HEAP_RAW_SIZE_15 + \
HEAP_RAW_SIZE_16 + \
HEAP_RAW_SIZE_17 + \
HEAP_RAW_SIZE_18 + \
HEAP_RAW_SIZE_19 + \
HEAP_RAW_SIZE_20 + \
HEAP_RAW_SIZE_21
```

Definition at line 161 of file system_heap.h.

14.161.2.2 #define HEAP_RAW_SIZE_1 ((HEAP_BLOCK_SIZE_1 + sizeof(LinkListNode) + sizeof(void*)) * HEAP_BLOCK_COUNT_1)

Really ugly computations used to auto-size the heap footprint based on the user-configuration data.

(don't touch this!!!)

Definition at line 35 of file system_heap.h.

14.162 system_heap.h

```
00001 /*=============================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__    __|_    |__    __|__    |__    __| __   |__   ______
00004 |    \  /   | ||    \       ||      |      ||   |/ /      ||___    |
00005 |     \/    | ||     \      ||      \      ||      \      ||___    |
00006 |__/\__/|__|_||__|\__\   __||__|\__\   __||__|\__\   __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 =============================================================================*/
00021 #ifndef __SYSTEM_HEAP_H__
00022 #define __SYSTEM_HEAP_H__
00023
00024 #include "system_heap_config.h"
00025 #include "fixed_heap.h"
00026
00027 #if USE_SYSTEM_HEAP
00028
00029 //---------------------------------------------------------------------------
00034 #if HEAP_NUM_SIZES > 0
00035     #define HEAP_RAW_SIZE_1 ((HEAP_BLOCK_SIZE_1 + sizeof(LinkListNode) + sizeof(void*)) *
       HEAP_BLOCK_COUNT_1 )
00036 #else
00037     #define HEAP_RAW_SIZE_1 0
00038 #endif
00039
00040 #if HEAP_NUM_SIZES > 1
00041     #define HEAP_RAW_SIZE_2 ((HEAP_BLOCK_SIZE_2 + sizeof(LinkListNode) + sizeof(void*)) *
       HEAP_BLOCK_COUNT_2 )
00042 #else
00043     #define HEAP_RAW_SIZE_2 0
```

```
00044 #endif
00045
00046 #if HEAP_NUM_SIZES > 2
00047     #define HEAP_RAW_SIZE_3 ((HEAP_BLOCK_SIZE_3 + sizeof(LinkListNode) + sizeof(void*)) *
       HEAP_BLOCK_COUNT_3 )
00048 #else
00049     #define HEAP_RAW_SIZE_3 0
00050 #endif
00051
00052 #if HEAP_NUM_SIZES > 3
00053     #define HEAP_RAW_SIZE_4 ((HEAP_BLOCK_SIZE_4 + sizeof(LinkListNode) + sizeof(void*)) *
       HEAP_BLOCK_COUNT_4 )
00054 #else
00055     #define HEAP_RAW_SIZE_4 0
00056 #endif
00057
00058 #if HEAP_NUM_SIZES > 4
00059     #define HEAP_RAW_SIZE_5 ((HEAP_BLOCK_SIZE_5 + sizeof(LinkListNode) + sizeof(void*)) *
       HEAP_BLOCK_COUNT_5 )
00060 #else
00061     #define HEAP_RAW_SIZE_5 0
00062 #endif
00063
00064 #if HEAP_NUM_SIZES > 5
00065     #define HEAP_RAW_SIZE_6 ((HEAP_BLOCK_SIZE_6 + sizeof(LinkListNode) + sizeof(void*)) *
       HEAP_BLOCK_COUNT_6 )
00066 #else
00067     #define HEAP_RAW_SIZE_6 0
00068 #endif
00069
00070 #if HEAP_NUM_SIZES > 6
00071     #define HEAP_RAW_SIZE_7 ((HEAP_BLOCK_SIZE_7 + sizeof(LinkListNode) + sizeof(void*)) *
       HEAP_BLOCK_COUNT_7 )
00072 #else
00073     #define HEAP_RAW_SIZE_7 0
00074 #endif
00075
00076 #if HEAP_NUM_SIZES > 7
00077     #define HEAP_RAW_SIZE_8 ((HEAP_BLOCK_SIZE_8 + sizeof(LinkListNode) + sizeof(void*)) *
       HEAP_BLOCK_COUNT_8 )
00078 #else
00079     #define HEAP_RAW_SIZE_8 0
00080 #endif
00081
00082 #if HEAP_NUM_SIZES > 8
00083     #define HEAP_RAW_SIZE_9 ((HEAP_BLOCK_SIZE_9 + sizeof(LinkListNode) + sizeof(void*)) *
       HEAP_BLOCK_COUNT_9 )
00084 #else
00085     #define HEAP_RAW_SIZE_9 0
00086 #endif
00087
00088 #if HEAP_NUM_SIZES > 9
00089     #define HEAP_RAW_SIZE_10 ((HEAP_BLOCK_SIZE_10 + sizeof(LinkListNode) + sizeof(void*)) *
       HEAP_BLOCK_COUNT_10 )
00090 #else
00091     #define HEAP_RAW_SIZE_10 0
00092 #endif
00093
00094 #if HEAP_NUM_SIZES > 10
00095     #define HEAP_RAW_SIZE_11 ((HEAP_BLOCK_SIZE_11 + sizeof(LinkListNode) + sizeof(void*)) *
       HEAP_BLOCK_COUNT_11 )
00096 #else
00097     #define HEAP_RAW_SIZE_11 0
00098 #endif
00099
00100 #if HEAP_NUM_SIZES > 11
00101     #define HEAP_RAW_SIZE_12 ((HEAP_BLOCK_SIZE_12 + sizeof(LinkListNode) + sizeof(void*)) *
       HEAP_BLOCK_COUNT_12 )
00102 #else
00103     #define HEAP_RAW_SIZE_12 0
00104 #endif
00105
00106 #if HEAP_NUM_SIZES > 12
00107     #define HEAP_RAW_SIZE_13 ((HEAP_BLOCK_SIZE_13 + sizeof(LinkListNode) + sizeof(void*)) *
       HEAP_BLOCK_COUNT_13 )
00108 #else
00109     #define HEAP_RAW_SIZE_13 0
00110 #endif
00111
00112 #if HEAP_NUM_SIZES > 13
00113     #define HEAP_RAW_SIZE_14 ((HEAP_BLOCK_SIZE_14 + sizeof(LinkListNode) + sizeof(void*)) *
       HEAP_BLOCK_COUNT_14 )
00114 #else
00115     #define HEAP_RAW_SIZE_14 0
00116 #endif
00117
00118 #if HEAP_NUM_SIZES > 14
```

```
00119     #define HEAP_RAW_SIZE_15 ((HEAP_BLOCK_SIZE_15 + sizeof(LinkListNode) + sizeof(void*)) *
       HEAP_BLOCK_COUNT_15 )
00120 #else
00121     #define HEAP_RAW_SIZE_15 0
00122 #endif
00123
00124 #if HEAP_NUM_SIZES > 15
00125     #define HEAP_RAW_SIZE_16 ((HEAP_BLOCK_SIZE_16 + sizeof(LinkListNode) + sizeof(void*)) *
       HEAP_BLOCK_COUNT_16 )
00126 #else
00127     #define HEAP_RAW_SIZE_16 0
00128 #endif
00129
00130 #if HEAP_NUM_SIZES > 16
00131     #define HEAP_RAW_SIZE_17 ((HEAP_BLOCK_SIZE_17 + sizeof(LinkListNode) + sizeof(void*)) *
       HEAP_BLOCK_COUNT_17 )
00132 #else
00133     #define HEAP_RAW_SIZE_17 0
00134 #endif
00135
00136 #if HEAP_NUM_SIZES > 17
00137     #define HEAP_RAW_SIZE_18 ((HEAP_BLOCK_SIZE_18 + sizeof(LinkListNode) + sizeof(void*)) *
       HEAP_BLOCK_COUNT_18 )
00138 #else
00139     #define HEAP_RAW_SIZE_18 0
00140 #endif
00141
00142 #if HEAP_NUM_SIZES > 18
00143     #define HEAP_RAW_SIZE_19 ((HEAP_BLOCK_SIZE_19 + sizeof(LinkListNode) + sizeof(void*)) *
       HEAP_BLOCK_COUNT_19 )
00144 #else
00145     #define HEAP_RAW_SIZE_19 0
00146 #endif
00147
00148 #if HEAP_NUM_SIZES > 19
00149     #define HEAP_RAW_SIZE_20 ((HEAP_BLOCK_SIZE_20 + sizeof(LinkListNode) + sizeof(void*)) *
       HEAP_BLOCK_COUNT_20 )
00150 #else
00151     #define HEAP_RAW_SIZE_20 0
00152 #endif
00153
00154 #if HEAP_NUM_SIZES > 20
00155     #define HEAP_RAW_SIZE_21 ((HEAP_BLOCK_SIZE_21 + sizeof(LinkListNode) + sizeof(void*)) *
       HEAP_BLOCK_COUNT_21 )
00156 #else
00157     #define HEAP_RAW_SIZE_21 0
00158 #endif
00159
00160 //---------------------------------------------------------------------------
00161 #define HEAP_RAW_SIZE   \
00162 HEAP_RAW_SIZE_1 + \
00163 HEAP_RAW_SIZE_2 + \
00164 HEAP_RAW_SIZE_3 + \
00165 HEAP_RAW_SIZE_4 + \
00166 HEAP_RAW_SIZE_5 + \
00167 HEAP_RAW_SIZE_6 + \
00168 HEAP_RAW_SIZE_7 + \
00169 HEAP_RAW_SIZE_8 + \
00170 HEAP_RAW_SIZE_9 + \
00171 HEAP_RAW_SIZE_10 + \
00172 HEAP_RAW_SIZE_11 + \
00173 HEAP_RAW_SIZE_12 + \
00174 HEAP_RAW_SIZE_13 + \
00175 HEAP_RAW_SIZE_14 + \
00176 HEAP_RAW_SIZE_15 + \
00177 HEAP_RAW_SIZE_16 + \
00178 HEAP_RAW_SIZE_17 + \
00179 HEAP_RAW_SIZE_18 + \
00180 HEAP_RAW_SIZE_19 + \
00181 HEAP_RAW_SIZE_20 + \
00182 HEAP_RAW_SIZE_21
00183
00184 //---------------------------------------------------------------------------
00189 class SystemHeap
00190 {
00191 public:
00195     static void  Init(void);
00196
00203     static void* Alloc(K_USHORT usSize_);
00204
00209     static void  Free(void *pvData_);
00210
00211 private:
00212     static K_UCHAR m_pucRawHeap[ HEAP_RAW_SIZE ];
00213     static HeapConfig m_pclSystemHeapConfig[
      HEAP_NUM_SIZES + 1 ];
00214     static FixedHeap m_clSystemHeap;
```

```
00215     static bool m_bInit;
00216 };
00217
00218 #endif // USE_SYSTEM_HEAP
00219
00220 #endif // __SYSTEM_HEAP_H__
```

14.163 /home/moslevin2/mark3/embedded/stage/src/system_heap_config.h File Reference

System heap configuration - defines the block sizes and counts used to fulfill system/service allocations.

```
#include "kerneltypes.h"
```

Macros

- #define USE_SYSTEM_HEAP (1)

  Set this to "1" if you want the system heap to be built as part of this library.
- #define HEAP_NUM_SIZES (3)

  Define the number of heap block sizes that we want to have attached to our system heap.
- #define HEAP_BLOCK_SIZE_1 ((K_USHORT) 8)

  Define the block sizes for each of the fixed-size blocks that will be managed by our heaps.
- #define **HEAP_BLOCK_SIZE_2** ((K_USHORT) 16)
- #define **HEAP_BLOCK_SIZE_3** ((K_USHORT) 24)
- #define **HEAP_BLOCK_SIZE_4** ((K_USHORT) 32)
- #define **HEAP_BLOCK_SIZE_5** ((K_USHORT) 48)
- #define **HEAP_BLOCK_SIZE_6** ((K_USHORT) 64)
- #define **HEAP_BLOCK_SIZE_7** ((K_USHORT) 96)
- #define **HEAP_BLOCK_SIZE_8** ((K_USHORT) 128)
- #define **HEAP_BLOCK_SIZE_9** ((K_USHORT) 192)
- #define **HEAP_BLOCK_SIZE_10** ((K_USHORT) 256)
- #define HEAP_BLOCK_COUNT_1 ((K_USHORT) 4)

  Define the number of blocks in each bin, tailored for a particular application.
- #define **HEAP_BLOCK_COUNT_2** ((K_USHORT) 4)
- #define **HEAP_BLOCK_COUNT_3** ((K_USHORT) 2)
- #define **HEAP_BLOCK_COUNT_4** ((K_USHORT) 2)
- #define **HEAP_BLOCK_COUNT_5** ((K_USHORT) 2)
- #define **HEAP_BLOCK_COUNT_6** ((K_USHORT) 2)
- #define **HEAP_BLOCK_COUNT_7** ((K_USHORT) 1)
- #define **HEAP_BLOCK_COUNT_8** ((K_USHORT) 1)
- #define **HEAP_BLOCK_COUNT_9** ((K_USHORT) 1)
- #define **HEAP_BLOCK_COUNT_10** ((K_USHORT) 1)

14.163.1 Detailed Description

System heap configuration - defines the block sizes and counts used to fulfill system/service allocations.

Definition in file system_heap_config.h.

14.163.2 Macro Definition Documentation

14.163.2.1 #define HEAP_BLOCK_SIZE_1 ((K_USHORT) 8)

Define the block sizes for each of the fixed-size blocks that will be managed by our heaps.

Must be defined in incrementing order.

Definition at line 44 of file system_heap_config.h.

14.164 system_heap_config.h

```
00001 /*===========================================================================
00002      _____     _____     _____     _____
00003  ___|    _|__ __|_    |__ __|__   |__ __| __  |__  _____
00004 |    \  /  | ||    \    ||     |     ||  |/ /     ||___   |
00005 |     \/   | ||     \   ||     \     ||  |  \     ||___   |
00006 |__/\__/|__|_||__|\__\ __||__|\__\  __||__|\__\ __||_____|
00007     |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]-------------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00020 #ifndef __SYSTEM_HEAP_CONFIG_H__
00021 #define __SYSTEM_HEAP_CONFIG_H__
00022
00023 #include "kerneltypes.h"
00024
00025 //---------------------------------------------------------------------------
00030 #define USE_SYSTEM_HEAP     (1)
00031
00032 //---------------------------------------------------------------------------
00037 #define HEAP_NUM_SIZES      (3)
00038
00039 //---------------------------------------------------------------------------
00044 #define HEAP_BLOCK_SIZE_1       ((K_USHORT) 8)
00045 #define HEAP_BLOCK_SIZE_2       ((K_USHORT) 16)
00046 #define HEAP_BLOCK_SIZE_3       ((K_USHORT) 24)
00047 #define HEAP_BLOCK_SIZE_4       ((K_USHORT) 32)
00048 #define HEAP_BLOCK_SIZE_5       ((K_USHORT) 48)
00049 #define HEAP_BLOCK_SIZE_6       ((K_USHORT) 64)
00050 #define HEAP_BLOCK_SIZE_7       ((K_USHORT) 96)
00051 #define HEAP_BLOCK_SIZE_8       ((K_USHORT) 128)
00052 #define HEAP_BLOCK_SIZE_9       ((K_USHORT) 192)
00053 #define HEAP_BLOCK_SIZE_10      ((K_USHORT) 256)
00054
00055 //---------------------------------------------------------------------------
00060 #define HEAP_BLOCK_COUNT_1      ((K_USHORT) 4)
00061 #define HEAP_BLOCK_COUNT_2      ((K_USHORT) 4)
00062 #define HEAP_BLOCK_COUNT_3      ((K_USHORT) 2)
00063 #define HEAP_BLOCK_COUNT_4      ((K_USHORT) 2)
00064 #define HEAP_BLOCK_COUNT_5      ((K_USHORT) 2)
00065 #define HEAP_BLOCK_COUNT_6      ((K_USHORT) 2)
00066 #define HEAP_BLOCK_COUNT_7      ((K_USHORT) 1)
00067 #define HEAP_BLOCK_COUNT_8      ((K_USHORT) 1)
00068 #define HEAP_BLOCK_COUNT_9      ((K_USHORT) 1)
00069 #define HEAP_BLOCK_COUNT_10     ((K_USHORT) 1)
00070
00071 #endif
00072
```

14.165 /home/moslevin2/mark3/embedded/stage/src/thread.cpp File Reference

Platform-Independent thread class Definition.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "thread.h"
#include "scheduler.h"
#include "kernelswi.h"
#include "timerlist.h"
#include "ksemaphore.h"
#include "quantum.h"
#include "kernel.h"
#include "kernel_debug.h"
```

Macros

- #define **__FILE_ID__** THREAD_CPP

Functions

- static void ThreadSleepCallback (Thread *pclOwner_, void *pvData_)

  This callback is used to wake up a thread once the interval has expired.

14.165.1 Detailed Description

Platform-Independent thread class Definition.

Definition in file thread.cpp.

14.166 thread.cpp

```
00001 /*============================================================================
00002     _____       _____       _____       _____
00003  ___|    _|__  __|_    |__  __|__   |__  __| __  |__  _______
00004 |    \  /  | ||    \       ||     |     ||  |/ /     ||___    |
00005 |     \/   | ||     \      ||     \     ||     \     ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||_______|
00007     |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ============================================================================*/
00022 #include "kerneltypes.h"
00023 #include "mark3cfg.h"
00024
00025 #include "thread.h"
00026 #include "scheduler.h"
00027 #include "kernelswi.h"
00028 #include "timerlist.h"
00029 #include "ksemaphore.h"
00030 #include "quantum.h"
00031 #include "kernel.h"
00032 #include "kernel_debug.h"
00033
00034 //---------------------------------------------------------------------------
00035 #if defined __FILE_ID__
00036     #undef __FILE_ID__
00037 #endif
00038 #define __FILE_ID__     THREAD_CPP
00039
00040 //---------------------------------------------------------------------------
00041 void Thread::Init(  K_UCHAR *paucStack_,
00042                 K_USHORT usStackSize_,
00043                 K_UCHAR ucPriority_,
00044                 ThreadEntry_t pfEntryPoint_,
00045                 void *pvArg_ )
00046 {
```

```
00047     static K_UCHAR ucThreadID = 0;
00048 
00049     KERNEL_ASSERT( paucStack_ );
00050     KERNEL_ASSERT( pfEntryPoint_ );
00051 
00052     m_ucThreadID = ucThreadID++;
00053 
00054     KERNEL_TRACE_1( STR_STACK_SIZE_1, usStackSize_ );
00055     KERNEL_TRACE_1( STR_PRIORITY_1, (K_UCHAR)ucPriority_ );
00056     KERNEL_TRACE_1( STR_THREAD_ID_1, (K_USHORT)m_ucThreadID );
00057     KERNEL_TRACE_1( STR_ENTRYPOINT_1, (K_USHORT)pfEntryPoint_ );
00058 
00059     // Initialize the thread parameters to their initial values.
00060     m_paucStack = paucStack_;
00061     m_paucStackTop = TOP_OF_STACK(paucStack_, usStackSize_);
00062 
00063     m_usStackSize = usStackSize_;
00064 
00065 #if KERNEL_USE_QUANTUM
00066     m_usQuantum = 4;
00067 #endif
00068 
00069     m_ucPriority = ucPriority_;
00070     m_ucCurPriority = m_ucPriority;
00071     m_pfEntryPoint = pfEntryPoint_;
00072     m_pvArg = pvArg_;
00073 
00074 #if KERNEL_USE_THREADNAME
00075     m_szName = NULL;
00076 #endif
00077 
00078     // Call CPU-specific stack initialization
00079     ThreadPort::InitStack(this);
00080 
00081     // Add to the global "stop" list.
00082     CS_ENTER();
00083     m_pclOwner = Scheduler::GetThreadList(
      m_ucPriority);
00084     m_pclCurrent = Scheduler::GetStopList();
00085     m_pclCurrent->Add(this);
00086     CS_EXIT();
00087 }
00088 
00089 //---------------------------------------------------------------------------
00090 void Thread::Start(void)
00091 {
00092     // Remove the thread from the scheduler's "stopped" list, and add it
00093     // to the scheduler's ready list at the proper priority.
00094     KERNEL_TRACE_1( STR_THREAD_START_1, (K_USHORT)m_ucThreadID );
00095 
00096     CS_ENTER();
00097     Scheduler::GetStopList()->Remove(this);
00098     Scheduler::Add(this);
00099     m_pclOwner = Scheduler::GetThreadList(
      m_ucPriority);
00100     m_pclCurrent = m_pclOwner;
00101 
00102     if (Kernel::IsStarted())
00103     {
00104         if (m_ucPriority >= Scheduler::GetCurrentThread()->
      GetCurPriority())
00105         {
00106 #if KERNEL_USE_QUANTUM
00107             // Deal with the thread Quantum
00108             Quantum::RemoveThread();
00109             Quantum::AddThread(this);
00110 #endif
00111         }
00112         if (m_ucPriority > Scheduler::GetCurrentThread()->
      GetPriority())
00113         {
00114             Thread::Yield();
00115         }
00116     }
00117     CS_EXIT();
00118 }
00119 
00120 //---------------------------------------------------------------------------
00121 void Thread::Stop()
00122 {
00123     K_UCHAR bReschedule = 0;
00124 
00125     CS_ENTER();
00126 
00127     // If a thread is attempting to stop itself, ensure we call the scheduler
00128     if (this == Scheduler::GetCurrentThread())
00129     {
```

```
00130         bReschedule = true;
00131     }
00132 
00133     // Add this thread to the stop-list (removing it from active scheduling)
00134     Scheduler::Remove(this);
00135     m_pclOwner = Scheduler::GetStopList();
00136     m_pclCurrent = m_pclOwner;
00137     m_pclOwner->Add(this);
00138 
00139     CS_EXIT();
00140 
00141     if (bReschedule)
00142     {
00143         Thread::Yield();
00144     }
00145 }
00146 
00147 #if KERNEL_USE_DYNAMIC_THREADS
00148 //---------------------------------------------------------------------------
00149 void Thread::Exit()
00150 {
00151     K_UCHAR bReschedule = 0;
00152 
00153     KERNEL_TRACE_1( STR_THREAD_EXIT_1, m_ucThreadID );
00154 
00155     CS_ENTER();
00156 
00157     // If this thread is the actively-running thread, make sure we run the
00158     // scheduler again.
00159     if (this == Scheduler::GetCurrentThread())
00160     {
00161         bReschedule = 1;
00162     }
00163 
00164     // Remove the thread from scheduling
00165     m_pclCurrent->Remove(this);
00166 
00167     CS_EXIT();
00168 
00169     if (bReschedule)
00170     {
00171         // Choose a new "next" thread if we must
00172         Thread::Yield();
00173     }
00174 }
00175 #endif
00176 
00177 #if KERNEL_USE_SLEEP
00178 //---------------------------------------------------------------------------
00180 static void ThreadSleepCallback( Thread *pclOwner_, void *pvData_ )
00181 {
00182     Semaphore *pclSemaphore = static_cast<Semaphore*>(pvData_);
00183     // Post the semaphore, which will wake the sleeping thread.
00184     pclSemaphore->Post();
00185 }
00186 
00187 //---------------------------------------------------------------------------
00188 void Thread::Sleep(K_ULONG ulTimeMs_)
00189 {
00190     Timer clTimer;
00191     Semaphore clSemaphore;
00192 
00193     // Create a semaphore that this thread will block on
00194     clSemaphore.Init(0, 1);
00195 
00196     // Create a one-shot timer that will call a callback that posts the
00197     // semaphore, waking our thread.
00198     clTimer.SetIntervalMSeconds(ulTimeMs_);
00199     clTimer.SetCallback(ThreadSleepCallback);
00200     clTimer.SetData((void*)&clSemaphore);
00201     clTimer.SetFlags(TIMERLIST_FLAG_ONE_SHOT);
00202 
00203     // Add the new timer to the timer scheduler, and block the thread
00204     TimerScheduler::Add(&clTimer);
00205     clSemaphore.Pend();
00206 
00207 }
00208 
00209 //---------------------------------------------------------------------------
00210 void Thread::USleep(K_ULONG ulTimeUs_)
00211 {
00212     Timer clTimer;
00213     Semaphore clSemaphore;
00214 
00215     // Create a semaphore that this thread will block on
00216     clSemaphore.Init(0, 1);
00217 
```

```
00218     // Create a one-shot timer that will call a callback that posts the
00219     // semaphore, waking our thread.
00220     clTimer.SetIntervalUSeconds(ulTimeUs_);
00221     clTimer.SetCallback(ThreadSleepCallback);
00222     clTimer.SetData((void*)&clSemaphore);
00223     clTimer.SetFlags(TIMERLIST_FLAG_ONE_SHOT);
00224 
00225     // Add the new timer to the timer scheduler, and block the thread
00226     TimerScheduler::Add(&clTimer);
00227     clSemaphore.Pend();
00228 }
00229 #endif // KERNEL_USE_SLEEP
00230 
00231 //---------------------------------------------------------------------------
00232 K_USHORT Thread::GetStackSlack()
00233 {
00234     K_USHORT usCount = 0;
00235 
00236     CS_ENTER();
00237 
00239     for (usCount = 0; usCount < m_usStackSize; usCount++)
00240     {
00241         if (m_paucStack[usCount] != 0xFF)
00242         {
00243             break;
00244         }
00245     }
00246 
00247     CS_EXIT();
00248 
00249     return usCount;
00250 }
00251 
00252 //---------------------------------------------------------------------------
00253 void Thread::Yield()
00254 {
00255     CS_ENTER();
00256 
00257     // Run the scheduler
00258     Scheduler::Schedule();
00259 
00260     // Only switch contexts if the new task is different than the old task
00261     if (Scheduler::GetCurrentThread() !=
      Scheduler::GetNextThread())
00262     {
00263 #if KERNEL_USE_QUANTUM
00264         // new thread scheduled.  Stop current quantum timer (if it exists),
00265         // and restart it for the new thread (if required).
00266         Quantum::RemoveThread();
00267         Quantum::AddThread(g_pstNext);
00268 #endif
00269 
00270         Thread::ContextSwitchSWI();
00271     }
00272 
00273     CS_EXIT();
00274 }
00275 
00276 //---------------------------------------------------------------------------
00277 void Thread::SetPriorityBase(K_UCHAR ucPriority_)
00278 {
00279      GetCurrent()->Remove(this);
00280 
00281      SetCurrent(Scheduler::GetThreadList(
      m_ucPriority));
00282 
00283      GetCurrent()->Add(this);
00284 }
00285 
00286 //---------------------------------------------------------------------------
00287 void Thread::SetPriority(K_UCHAR ucPriority_)
00288 {
00289     K_UCHAR bSchedule = 0;
00290     CS_ENTER();
00291     // If this is the currently running thread, it's a good idea to reschedule
00292     // Or, if the new priority is a higher priority than the current thread's.
00293     if ((g_pstCurrent == this) || (ucPriority_ > g_pstCurrent->GetPriority()))
00294     {
00295         bSchedule = 1;
00296     }
00297     CS_EXIT();
00298 
00299     Scheduler::Remove(this);
00300 
00301     m_ucCurPriority = ucPriority_;
00302     m_ucPriority = ucPriority_;
00303 
```

```
00304     CS_ENTER();
00305     Scheduler::Add(this);
00306     CS_EXIT();
00307 
00308     if (bSchedule)
00309     {
00310         CS_ENTER();
00311         Scheduler::Schedule();
00312 #if KERNEL_USE_QUANTUM
00313         // new thread scheduled.  Stop current quantum timer (if it exists),
00314         // and restart it for the new thread (if required).
00315         Quantum::RemoveThread();
00316         Quantum::AddThread(g_pstNext);
00317 #endif
00318         CS_EXIT();
00319         Thread::ContextSwitchSWI();
00320     }
00321 }
00322 
00323 //---------------------------------------------------------------------------
00324 void Thread::InheritPriority(K_UCHAR ucPriority_)
00325 {
00326     SetOwner(Scheduler::GetThreadList(ucPriority_));
00327     m_ucCurPriority = ucPriority_;
00328 }
00329 
00330 //---------------------------------------------------------------------------
00331 void Thread::ContextSwitchSWI()
00332 {
00333     // Call the context switch interrupt if the scheduler is enabled.
00334     if (Scheduler::IsEnabled() == 1)
00335     {
00336         KERNEL_TRACE_1( STR_CONTEXT_SWITCH_1, (K_USHORT)g_pstNext->GetID() );
00337         KernelSWI::Trigger();
00338     }
00339 }
00340 
00341 
```

14.167 /home/moslevin2/mark3/embedded/stage/src/thread.h File Reference

Platform independent thread class declarations.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "ll.h"
#include "threadlist.h"
#include "scheduler.h"
#include "threadport.h"
#include "quantum.h"
```

Classes

- class Thread

  Object providing fundamental multitasking support in the kernel.

Macros

- #define THREAD_QUANTUM_DEFAULT (4)

  Suggested default thread quantum.

Typedefs

- typedef void(* ThreadEntry_t)(void *pvArg_)

  Function pointer type used for thread entrypoint functions.

14.167.1 Detailed Description

Platform independent thread class declarations. Threads are an atomic unit of execution, and each instance of the thread class represents an instance of a program running of the processor. The Thread is the fundmanetal user-facing object in the kernel - it is what makes multiprocessing possible from application code.

In Mark3, threads each have their own context - consisting of a stack, and all of the registers required to multiplex a processor between multiple threads.

The Thread class inherits directly from the LinkListNode class to facilitate efficient thread management using Double, or Double-Circular linked lists.

Definition in file thread.h.

14.168 thread.h

```
00001 /*===========================================================================
00002     _____       _____       _____       _____
00003  ___|    _|__  __|_    |__  __|__    |__  __| __  |__  _______
00004 |    \  /  | ||    \       ||     |     ||  |/ /     ||___    |
00005 |     \/   | ||     \      ||     \     ||     \     ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||_______|
00007    |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00035 #ifndef __THREAD_H__
00036 #define __THREAD_H__
00037
00038 #include "kerneltypes.h"
00039 #include "mark3cfg.h"
00040
00041 #include "ll.h"
00042 #include "threadlist.h"
00043 #include "scheduler.h"
00044 #include "threadport.h"
00045 #include "quantum.h"
00046
00047 //---------------------------------------------------------------------------
00049 #define THREAD_QUANTUM_DEFAULT      (4)
00050
00051 //---------------------------------------------------------------------------
00055 typedef void (*ThreadEntry_t)(void *pvArg_);
00056
00057 //---------------------------------------------------------------------------
00058 class ThreadPort;
00059
00060 //---------------------------------------------------------------------------
00064 class Thread : public LinkListNode
00065 {
00066 public:
00086     void Init(K_UCHAR *paucStack_,
00087               K_USHORT usStackSize_,
00088               K_UCHAR ucPriority_,
00089               ThreadEntry_t pfEntryPoint_,
00090               void *pvArg_ );
00091
00099     void Start();
00100
00101
00108     void Stop();
00109
00110 #if KERNEL_USE_THREADNAME
00111
00120     void SetName(const K_CHAR *szName_) { m_szName = szName_; }
00121
00128     const K_CHAR* GetName() { return m_szName; }
00129 #endif
00130
00139     ThreadList *GetOwner(void) { return m_pclOwner; }
00140
00148     ThreadList *GetCurrent(void) { return m_pclCurrent; }
00149
00158     K_UCHAR GetPriority(void) { return m_ucPriority; }
00159
00167     K_UCHAR GetCurPriority(void) { return m_ucCurPriority; }
```

```
00168
00169 #if KERNEL_USE_QUANTUM
00170
00177     void SetQuantum( K_USHORT usQuantum_ ) { m_usQuantum = usQuantum_; }
00178
00186     K_USHORT GetQuantum(void) { return m_usQuantum; }
00187 #endif
00188
00196     void SetCurrent( ThreadList *pclNewList_ ) {
      m_pclCurrent = pclNewList_; }
00197
00205     void SetOwner( ThreadList *pclNewList_ ) { m_pclOwner = pclNewList_; }
00206
00207
00220     void SetPriority(K_UCHAR ucPriority_);
00221
00231     void InheritPriority(K_UCHAR ucPriority_);
00232
00233 #if KERNEL_USE_DYNAMIC_THREADS
00234
00245     void Exit();
00246 #endif
00247
00248 #if KERNEL_USE_SLEEP
00249
00257     static void Sleep(K_ULONG ulTimeMs_);
00258
00267     static void USleep(K_ULONG ulTimeUs_);
00268 #endif
00269
00277     static void Yield(void);
00278
00286     void SetID( K_UCHAR ucID_ ) { m_ucThreadID = ucID_; }
00287
00295     K_UCHAR GetID() { return m_ucThreadID; }
00296
00297
00310     K_USHORT GetStackSlack();
00311
00312     friend class ThreadPort;
00313
00314 private:
00322     static void ContextSwitchSWI(void);
00323
00328     void SetPriorityBase(K_UCHAR ucPriority_);
00329
00331     K_UCHAR *m_paucStackTop;
00332
00334     K_UCHAR *m_paucStack;
00335
00337     K_USHORT m_usStackSize;
00338
00339 #if KERNEL_USE_QUANTUM
00340
00341     K_USHORT m_usQuantum;
00342 #endif
00343
00345     K_UCHAR m_ucThreadID;
00346
00348     K_UCHAR m_ucPriority;
00349
00351     K_UCHAR m_ucCurPriority;
00352
00354     ThreadEntry_t m_pfEntryPoint;
00355
00357     void *m_pvArg;
00358
00359 #if KERNEL_USE_THREADNAME
00360
00361     const K_CHAR *m_szName;
00362 #endif
00363
00365     ThreadList *m_pclCurrent;
00366
00368     ThreadList *m_pclOwner;
00369 };
00370
00371 #endif
```

14.169 /home/moslevin2/mark3/embedded/stage/src/threadlist.cpp File Reference

Thread linked-list definitions.

```
#include "kerneltypes.h"
#include "ll.h"
#include "threadlist.h"
#include "thread.h"
#include "kernel_debug.h"
```

Macros

- #define **__FILE_ID__** THREADLIST_CPP

14.169.1 Detailed Description

Thread linked-list definitions.

Definition in file threadlist.cpp.

14.170 threadlist.cpp

```
00001 /*=========================================================================
00002      _____        _____        _____        _____
00003  ___|    _|__  __|_    |__  __|__   |__  __| __  |__  ______
00004 |    \  /  | ||    \       ||      |      ||  |/ /     ||___   |
00005 |     \/   | ||     \      ||      \      ||     \     ||___   |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 =========================================================================*/
00022 #include "kerneltypes.h"
00023 #include "ll.h"
00024 #include "threadlist.h"
00025 #include "thread.h"
00026 #include "kernel_debug.h"
00027 //---------------------------------------------------------------------------
00028 #if defined __FILE_ID__
00029     #undef __FILE_ID__
00030 #endif
00031 #define __FILE_ID__     THREADLIST_CPP
00032
00033 //---------------------------------------------------------------------------
00034 void ThreadList::SetPriority(K_UCHAR ucPriority_)
00035 {
00036     m_ucPriority = ucPriority_;
00037 }
00038
00039 //---------------------------------------------------------------------------
00040 void ThreadList::SetFlagPointer( K_UCHAR *pucFlag_)
00041 {
00042     m_pucFlag = pucFlag_;
00043 }
00044
00045 //---------------------------------------------------------------------------
00046 void ThreadList::Add(LinkListNode *node_) {
00047     CircularLinkList::Add(node_);
00048
00049     // If the head of the list isn't empty,
00050     if (m_pstHead != NULL)
00051     {
00052         // We've specified a bitmap for this threadlist
00053         if (m_pucFlag)
00054         {
00055             // Set the flag for this priority level
00056             *m_pucFlag |= (1 << m_ucPriority);
00057         }
00058     }
00059 }
00060
00061 //---------------------------------------------------------------------------
00062 void ThreadList::Add(LinkListNode *node_, K_UCHAR *pucFlag_, K_UCHAR ucPriority_
      ) {
```

```
00063     // Set the threadlist's priority level, flag pointer, and then add the
00064     // thread to the threadlist
00065     SetPriority(ucPriority_);
00066     SetFlagPointer(pucFlag_);
00067     Add(node_);
00068 }
00069
00070 //---------------------------------------------------------------------------
00071 void ThreadList::Remove(LinkListNode *node_) {
00072     // Remove the thread from the list
00073     CircularLinkList::Remove(node_);
00074
00075     // If the list is empty...
00076     if (!m_pstHead)
00077     {
00078         // Clear the bit in the bitmap at this priority level
00079         if (m_pucFlag)
00080         {
00081             *m_pucFlag &= ~(1 << m_ucPriority);
00082         }
00083     }
00084 }
00085
00086 //---------------------------------------------------------------------------
00087 Thread *ThreadList::HighestWaiter()
00088 {
00089     Thread *pclTemp = static_cast<Thread*>(GetHead());
00090     Thread *pclChosen = pclTemp;
00091
00092     K_UCHAR ucMaxPri = 0;
00093
00094     // Go through the list, return the highest-priority thread in this list.
00095     while(1)
00096     {
00097         // Compare against current max-priority thread
00098         if (pclTemp->GetPriority() >= ucMaxPri)
00099         {
00100             ucMaxPri = pclTemp->GetPriority();
00101             pclChosen = pclTemp;
00102         }
00103
00104         // Break out if this is the last thread in the list
00105         if (pclTemp == static_cast<Thread*>(GetTail()))
00106         {
00107             break;
00108         }
00109
00110         pclTemp = static_cast<Thread*>(pclTemp->GetNext());
00111     }
00112     return pclChosen;
00113 }
```

14.171 /home/moslevin2/mark3/embedded/stage/src/threadlist.h File Reference

Thread linked-list declarations.

```
#include "kerneltypes.h"
#include "ll.h"
```

Classes

- class ThreadList

  This class is used for building thread-management facilities, such as schedulers, and blocking objects.

14.171.1 Detailed Description

Thread linked-list declarations.

Definition in file threadlist.h.

14.172 threadlist.h

```
/*===========================================================================
     _____       _____       _____       _____
 ___|    _|__  __|_    |__  __|__   |__  __| __  |__  ______
|    \  /  | ||    \      ||     |      ||  |/ /     ||___   |
|     \/   | ||     \     ||     \      ||     \     ||___   |
|__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
    |_____|      |_____|      |_____|      |_____|

--[Mark3 Realtime Platform]--------------------------------------------------

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===========================================================================*/
#ifndef __THREADLIST_H__
#define __THREADLIST_H__

#include "kerneltypes.h"
#include "ll.h"

class Thread;

class ThreadList : public CircularLinkList
{
public:
    ThreadList() { m_ucPriority = 0; m_pucFlag = NULL; }

    void SetPriority(K_UCHAR ucPriority_);

    void SetFlagPointer(K_UCHAR *pucFlag_);

    void Add(LinkListNode *node_);

    void Add(LinkListNode *node_, K_UCHAR *pucFlag_, K_UCHAR ucPriority_);

    void Remove(LinkListNode *node_);

    Thread *HighestWaiter();
private:

    K_UCHAR m_ucPriority;

    K_UCHAR *m_pucFlag;
};

#endif

```

14.173 /home/moslevin2/mark3/embedded/stage/src/threadport.cpp File Reference

ATMega328p Multithreading.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "thread.h"
#include "threadport.h"
#include "kernelswi.h"
#include "kerneltimer.h"
#include "timerlist.h"
#include "quantum.h"
#include <avr/io.h>
#include <avr/interrupt.h>
```

Functions

- static void **Thread_Switch** (void)
- ISR (INT0_vect) __attribute__((signal

    SWI using INT0 - used to trigger a context switch.
- ISR (TIMER1_COMPA_vect)

Timer interrupt ISR - causes a tick, which may cause a context switch.

Variables

- Thread * **g_pstCurrentThread**
- **naked**

14.173.1 Detailed Description

ATMega328p Multithreading.

Definition in file threadport.cpp.

14.174 threadport.cpp

```
00001 /*===========================================================================
00002      _____          _____          _____          _____
00003  ___|    _|__   __|_    |__   __|__    |__   __| __   |__   ______
00004 |    \  /   | ||    \       ||      |     ||  |/ /     ||___    |
00005 |     \/    | ||     \      ||      \     ||     \     ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]-----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00022 #include "kerneltypes.h"
00023 #include "mark3cfg.h"
00024 #include "thread.h"
00025 #include "threadport.h"
00026 #include "kernelswi.h"
00027 #include "kerneltimer.h"
00028 #include "timerlist.h"
00029 #include "quantum.h"
00030 #include <avr/io.h>
00031 #include <avr/interrupt.h>
00032
00033 //---------------------------------------------------------------------------
00034 Thread *g_pstCurrentThread;
00035
00036 //---------------------------------------------------------------------------
00037 void ThreadPort::InitStack(Thread *pclThread_)
00038 {
00039     // Initialize the stack for a Thread
00040     K_USHORT usAddr;
00041     K_UCHAR *pucStack;
00042     K_USHORT i;
00043
00044     // Get the address of the thread's entry function
00045     usAddr = (K_USHORT)(pclThread_->m_pfEntryPoint);
00046
00047     // Start by finding the bottom of the stack
00048     pucStack = (K_UCHAR*)pclThread_->m_paucStackTop;
00049
00050     // clear the stack, and initialize it to a known-default value (easier
00051     // to debug when things go sour with stack corruption or overflow)
00052     for (i = 0; i < pclThread_->m_usStackSize; i++)
00053     {
00054         pclThread_->m_paucStack[i] = 0xFF;
00055     }
00056
00057     // Our context starts with the entry function
00058     PUSH_TO_STACK(pucStack, (K_UCHAR)(usAddr & 0x00FF));
00059     PUSH_TO_STACK(pucStack, (K_UCHAR)((usAddr >> 8) & 0x00FF));
00060
00061     // R0
00062     PUSH_TO_STACK(pucStack, 0x00);    // R0
00063
00064     // Push status register and R1 (which is used as a constant zero)
00065     PUSH_TO_STACK(pucStack, 0x80);  // SR
00066     PUSH_TO_STACK(pucStack, 0x00);  // R1
00067
00068     // Push other registers
00069     for (i = 2; i <= 23; i++) //R2-R23
```

```
00070     {
00071         PUSH_TO_STACK(pucStack, i);
00072     }
00073 
00074     // Assume that the argument is the only stack variable
00075     PUSH_TO_STACK(pucStack, (K_UCHAR)(((K_USHORT)(pclThread_->
      m_pvArg)) & 0x00FF));     //R24
00076     PUSH_TO_STACK(pucStack, (K_UCHAR)((((K_USHORT)(pclThread_->
      m_pvArg))>>8) & 0x00FF)); //R25
00077 
00078     // Push the rest of the registers in the context
00079     for (i = 26; i <=31; i++)
00080     {
00081         PUSH_TO_STACK(pucStack, i);
00082     }
00083 
00084     // Set the top o' the stack.
00085     pclThread_->m_paucStackTop = (K_UCHAR*)pucStack;
00086 
00087     // That's it!  the thread is ready to run now.
00088 }
00089 
00090 //---------------------------------------------------------------------------
00091 static void Thread_Switch(void)
00092 {
00093     g_pstCurrent = g_pstNext;
00094 }
00095 
00096 
00097 //---------------------------------------------------------------------------
00098 void ThreadPort::StartThreads()
00099 {
00100     KernelSWI::Config();                // configure the task switch SWI
00101     KernelTimer::Config();                // configure the kernel timer
00102 
00103     Scheduler::SetScheduler(1);           // enable the scheduler
00104     Scheduler::Schedule();                // run the scheduler - determine the first
       thread to run
00105 
00106     Thread_Switch();                     // Set the next scheduled thread to the current thread
00107 
00108     KernelTimer::Start();               // enable the kernel timer
00109     KernelSWI::Start();                   // enable the task switch SWI
00110 
00111     // Restore the context...
00112     Thread_RestoreContext();        // restore the context of the first running thread
00113     ASM("reti");                    // return from interrupt - will return to the first scheduled thread
00114 }
00115 
00116 //---------------------------------------------------------------------------
00121 //---------------------------------------------------------------------------
00122 ISR(INT0_vect) __attribute__ ( ( signal, naked ) );
00123 ISR(INT0_vect)
00124 {
00125     Thread_SaveContext();         // Push the context (registers) of the current task
00126     Thread_Switch();            // Switch to the next task
00127     Thread_RestoreContext();    // Pop the context (registers) of the next task
00128     ASM("reti");                // Return to the next task
00129 }
00130 
00131 //---------------------------------------------------------------------------
00136 //---------------------------------------------------------------------------
00137 ISR(TIMER1_COMPA_vect)
00138 {
00139 #if KERNEL_USE_TIMERS
00140     TimerScheduler::Process();
00141 #endif
00142 #if KERNEL_USE_QUANTUM
00143     Quantum::UpdateTimer();
00144 #endif
00145 }
```

14.175 /home/moslevin2/mark3/embedded/stage/src/threadport.h File Reference

ATMega328p Multithreading support.

```
#include "kerneltypes.h"
#include "thread.h"
#include <avr/io.h>
#include <avr/interrupt.h>
```

Classes

- class ThreadPort

  Class defining the architecture specific functions required by the kernel.

Macros

- #define ASM(x) asm volatile(x);

  ASM Macro - simplify the use of ASM directive in C.
- #define SR_ 0x3F

  Status register define - map to 0x003F.
- #define SPH_ 0x3E

  Stack pointer define.
- #define **SPL_** 0x3D
- #define TOP_OF_STACK(x, y) (K_UCHAR*) (((K_USHORT)x) + (y-1))

  Macro to find the top of a stack given its size and top address.
- #define PUSH_TO_STACK(x, y) *x = y; x--;

  Push a value y to the stack pointer x and decrement the stack pointer.
- #define Thread_SaveContext()

  Save the context of the Thread.
- #define Thread_RestoreContext()

  Restore the context of the Thread.
- #define CS_ENTER()

  These macros must be used in pairs !
- #define CS_EXIT()

  Exit critical section (restore status register)
- #define ENABLE_INTS() ASM("sei");

  Initiate a contex switch without using the SWI.
- #define **DISABLE_INTS**() ASM("cli");

14.175.1 Detailed Description

ATMega328p Multithreading support.

Definition in file threadport.h.

14.175.2 Macro Definition Documentation

14.175.2.1 #define CS_ENTER( )

Value:

```
{ \
volatile K_UCHAR x; \
x = _SFR_IO8(SR_); \
ASM("cli");
```

These macros *must* be used in pairs !

Enter critical section (copy status register, disable interrupts)

Definition at line 142 of file threadport.h.

14.175.2.2 #define CS_EXIT( )

Value:

```
_SFR_IO8(SR_) = x;\
}
```

Exit critical section (restore status register)

Definition at line 149 of file threadport.h.

14.176 threadport.h

```
00001 /*=====================================================================================
00002 
00003  ___|     _|__  __|_     |__  __|__    |__  __| __  |__  _______
00004 |     \   /  | ||     \       ||      |      ||  |/ /      ||___    |
00005 |      \/    | ||      \      ||      \      ||     \      ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||_______|
00007     |______|       |______|       |______|       |______|
00008 
00009 --[Mark3 Realtime Platform]----------------------------------------------------
00010 
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 =====================================================================================*/
00021 #ifndef __THREADPORT_H_
00022 #define __THREADPORT_H_
00023 
00024 #include "kerneltypes.h"
00025 #include "thread.h"
00026 
00027 #include <avr/io.h>
00028 #include <avr/interrupt.h>
00029 
00030 //-------------------------------------------------------------------------------
00032 #define ASM(x)      asm volatile(x);
00033 
00034 #define SR_         0x3F
00035 
00036 #define SPH_        0x3E
00037 #define SPL_        0x3D
00038 
00039 
00040 //-------------------------------------------------------------------------------
00042 #define TOP_OF_STACK(x, y)        (K_UCHAR*) ( ((K_USHORT)x) + (y-1) )
00043 
00044 #define PUSH_TO_STACK(x, y)        *x = y; x--;
00045 
00046 //-------------------------------------------------------------------------------
00048 #define Thread_SaveContext() \
00049 ASM("push r0"); \
00050 ASM("in r0, __SREG__"); \
00051 ASM("cli"); \
00052 ASM("push r0"); \
00053 ASM("push r1"); \
00054 ASM("clr r1"); \
00055 ASM("push r2"); \
00056 ASM("push r3"); \
00057 ASM("push r4"); \
00058 ASM("push r5"); \
00059 ASM("push r6"); \
00060 ASM("push r7"); \
00061 ASM("push r8"); \
00062 ASM("push r9"); \
00063 ASM("push r10"); \
00064 ASM("push r11"); \
00065 ASM("push r12"); \
00066 ASM("push r13"); \
00067 ASM("push r14"); \
00068 ASM("push r15"); \
00069 ASM("push r16"); \
00070 ASM("push r17"); \
00071 ASM("push r18"); \
00072 ASM("push r19"); \
00073 ASM("push r20"); \
00074 ASM("push r21"); \
00075 ASM("push r22"); \
00076 ASM("push r23"); \
00077 ASM("push r24"); \
```

```
00078 ASM("push r25"); \
00079 ASM("push r26"); \
00080 ASM("push r27"); \
00081 ASM("push r28"); \
00082 ASM("push r29"); \
00083 ASM("push r30"); \
00084 ASM("push r31"); \
00085 ASM("lds r26, g_pstCurrent"); \
00086 ASM("lds r27, g_pstCurrent + 1"); \
00087 ASM("adiw r26, 4"); \
00088 ASM("in    r0, 0x3D"); \
00089 ASM("st    x+, r0"); \
00090 ASM("in    r0, 0x3E"); \
00091 ASM("st    x+, r0");
00092
00093 //---------------------------------------------------------------------------
00095 #define Thread_RestoreContext() \
00096 ASM("lds r26, g_pstCurrent"); \
00097 ASM("lds r27, g_pstCurrent + 1");\
00098 ASM("adiw r26, 4"); \
00099 ASM("ld     r28, x+"); \
00100 ASM("out 0x3D, r28"); \
00101 ASM("ld     r29, x+"); \
00102 ASM("out 0x3E, r29"); \
00103 ASM("pop r31"); \
00104 ASM("pop r30"); \
00105 ASM("pop r29"); \
00106 ASM("pop r28"); \
00107 ASM("pop r27"); \
00108 ASM("pop r26"); \
00109 ASM("pop r25"); \
00110 ASM("pop r24"); \
00111 ASM("pop r23"); \
00112 ASM("pop r22"); \
00113 ASM("pop r21"); \
00114 ASM("pop r20"); \
00115 ASM("pop r19"); \
00116 ASM("pop r18"); \
00117 ASM("pop r17"); \
00118 ASM("pop r16"); \
00119 ASM("pop r15"); \
00120 ASM("pop r14"); \
00121 ASM("pop r13"); \
00122 ASM("pop r12"); \
00123 ASM("pop r11"); \
00124 ASM("pop r10"); \
00125 ASM("pop r9"); \
00126 ASM("pop r8"); \
00127 ASM("pop r7"); \
00128 ASM("pop r6"); \
00129 ASM("pop r5"); \
00130 ASM("pop r4"); \
00131 ASM("pop r3"); \
00132 ASM("pop r2"); \
00133 ASM("pop r1"); \
00134 ASM("pop r0"); \
00135 ASM("out __SREG__, r0"); \
00136 ASM("pop r0");
00137
00138 //---------------------------------------------------------------------------
00140 //---------------------------------------------------------------------------
00142 #define CS_ENTER()    \
00143 { \
00144 volatile K_UCHAR x; \
00145 x = _SFR_IO8(SR_); \
00146 ASM("cli");
00147 //---------------------------------------------------------------------------
00149 #define CS_EXIT() \
00150 _SFR_IO8(SR_) = x;\
00151 }
00152
00153 //---------------------------------------------------------------------------
00155 #define ENABLE_INTS()        ASM("sei");
00156 #define DISABLE_INTS()       ASM("cli");
00157
00158 //---------------------------------------------------------------------------
00159 class Thread;
00167 class ThreadPort
00168 {
00169 public:
00175     static void StartThreads();
00176     friend class Thread;
00177 private:
00178
00186     static void InitStack(Thread *pstThread_);
00187 };
00188
```

```
00189 #endif //__ThreadPORT_H_
```

14.177 /home/moslevin2/mark3/embedded/stage/src/timerlist.cpp File Reference

Timer data structure + scheduler implementations.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "timerlist.h"
#include "kerneltimer.h"
#include "threadport.h"
#include "kernel_debug.h"
```

Macros

- #define **__FILE_ID__** TIMERLIST_CPP
- #define TL_FUDGE_FACTOR (0)

  Number of ticks to account for overhead when performing Time->tick computations.

14.177.1 Detailed Description

Timer data structure + scheduler implementations.

Definition in file timerlist.cpp.

14.177.2 Macro Definition Documentation

14.177.2.1 #define TL_FUDGE_FACTOR (0)

Number of ticks to account for overhead when performing Time->tick computations.

This must be calibrated on a per-device basis. This value is currently Set up for a 16-bit timer, with a 256 prescaler, 16MHz clock, on an ATMega328p (i.e. ARDUINO UNO).

!! Note - this is deprecated. Better to have slightly long-cycled timers than potentially short-cycled timers.

Definition at line 47 of file timerlist.cpp.

14.178 timerlist.cpp

```
00001 /*===========================================================================
00002      _____          _____          _____          _____
00003  ___|    _|__   ___|_    |__   ___|__    |__   ___| __   |__   ______
00004 |    \  /  | ||    \       ||      |     ||  |/ /     ||___    |
00005 |     \/   | ||     \      ||      \     ||     \     ||___    |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00022 #include "kerneltypes.h"
00023 #include "mark3cfg.h"
00024
00025 #include "timerlist.h"
00026 #include "kerneltimer.h"
00027 #include "threadport.h"
00028 #include "kernel_debug.h"
```

```
00029 //---------------------------------------------------------------------------
00030 #if defined __FILE_ID__
00031     #undef __FILE_ID__
00032 #endif
00033 #define __FILE_ID__     TIMERLIST_CPP
00034
00035 #if KERNEL_USE_TIMERS
00036
00037 //---------------------------------------------------------------------------
00047 #define TL_FUDGE_FACTOR             (0)
00048
00049 TimerList TimerScheduler::m_clTimerList;
00050 //---------------------------------------------------------------------------
00051 void TimerList::Init(void)
00052 {
00053     m_bTimerActive = 0;
00054     m_ulNextWakeup = 0;
00055 }
00056
00057 //---------------------------------------------------------------------------
00058 void TimerList::Add(Timer *pclListNode_)
00059 {
00060     K_LONG lDelta;
00061     K_UCHAR bStart = 0;
00062      CS_ENTER();
00063
00064     if (GetHead() == NULL)
00065     {
00066         bStart = 1;
00067     }
00068
00069     pclListNode_->ClearNode();
00070     DoubleLinkList::Add(pclListNode_);
00071
00072     // Set the initial timer value
00073     pclListNode_->m_ulTimeLeft = pclListNode_->m_ulInterval;
00074
00075     if (!bStart)
00076     {
00077         // If the new interval is less than the amount of time remaining...
00078         lDelta = KernelTimer::TimeToExpiry() - pclListNode_->
      m_ulInterval;
00079
00080         if (lDelta > 0)
00081         {
00082             // Set the new expiry time on the timer.
00083             m_ulNextWakeup = KernelTimer::SubtractExpiry((K_ULONG)
      lDelta);
00084         }
00085     }
00086     else
00087     {
00088         m_ulNextWakeup = pclListNode_->m_ulInterval;
00089         KernelTimer::SetExpiry(m_ulNextWakeup);
00090         KernelTimer::Start();
00091     }
00092     // Set the timer as active.
00093     pclListNode_->m_ucFlags |= TIMERLIST_FLAG_ACTIVE;
00094     CS_EXIT();
00095 }
00096
00097 //---------------------------------------------------------------------------
00098 void TimerList::Remove(Timer *pclLinkListNode_)
00099 {
00100     CS_ENTER();
00101
00102     DoubleLinkList::Remove(pclLinkListNode_);
00103
00104     if (this->GetHead() == NULL)
00105     {
00106         KernelTimer::Stop();
00107     }
00108
00109     CS_EXIT();
00110 }
00111
00112 //---------------------------------------------------------------------------
00113 void TimerList::Process(void)
00114 {
00115     K_ULONG ulNewExpiry;
00116     K_ULONG ulOvertime;
00117     K_UCHAR bContinue;
00118
00119     Timer *pclNode;
00120     Timer *pclPrev;
00121
00122     // Clear the timer and its expiry time - keep it running though
```

```
00123     KernelTimer::ClearExpiry();
00124 
00125     do
00126     {
00127         ulNewExpiry = MAX_TIMER_TICKS;
00128         pclNode = static_cast<Timer*>(GetHead());
00129         pclPrev = NULL;
00130         bContinue = 0;
00131 
00132         // Subtract the elapsed time interval from each active timer.
00133         while (pclNode)
00134         {
00135             // Active timers only...
00136             if (pclNode->m_ucFlags & TIMERLIST_FLAG_ACTIVE)
00137             {
00138                 // Did the timer expire?
00139                 if (pclNode->m_ulTimeLeft <= m_ulNextWakeup)
00140                 {
00141                     // Yes - set the "callback" flag - we'll execute the callbacks later
00142                     pclNode->m_ucFlags |= TIMERLIST_FLAG_CALLBACK;
00143 
00144                     if (pclNode->m_ucFlags & TIMERLIST_FLAG_ONE_SHOT)
00145                     {
00146                         // If this was a one-shot timer, deactivate the timer.
00147                         pclNode->m_ucFlags |= TIMERLIST_FLAG_EXPIRED;
00148                         pclNode->m_ucFlags &= ~TIMERLIST_FLAG_ACTIVE;

00149                     }
00150                     else
00151                     {
00152                         // Reset the interval timer.
00154                         // I think we're good though...
00155                         pclNode->m_ulTimeLeft = pclNode->
    m_ulInterval;
00156 
00157                         // If the time remaining is less than the expiry, set the new expiry.
00158                         if (pclNode->m_ulTimeLeft < ulNewExpiry)
00159                         {
00160                             ulNewExpiry = pclNode->m_ulTimeLeft;
00161                         }
00162                     }
00163                 }
00164                 else
00165                 {
00166                     // Not expiring, but determine how K_LONG to run the next timer interval for.
00167                     pclNode->m_ulTimeLeft -= m_ulNextWakeup;
00168                     if (pclNode->m_ulTimeLeft < ulNewExpiry)
00169                     {
00170                         ulNewExpiry = pclNode->m_ulTimeLeft;
00171                     }
00172                 }
00173 
00174             }
00175             pclNode = static_cast<Timer*>(pclNode->GetNext());
00176         }
00177 
00178         // Process the expired timers callbacks.
00179         pclNode = static_cast<Timer*>(GetHead());
00180         while (pclNode)
00181         {
00182             pclPrev = NULL;
00183 
00184             // If the timer expired, run the callbacks now.
00185             if (pclNode->m_ucFlags & TIMERLIST_FLAG_CALLBACK)
00186             {
00187                 // Run the callback. these callbacks must be very fast...
00188                 pclNode->m_pfCallback( pclNode->m_pclOwner, pclNode->
    m_pvData );
00189                 pclNode->m_ucFlags &= ~TIMERLIST_FLAG_CALLBACK;
00190 
00191                 // If this was a one-shot timer, let's remove it.
00192                 if (pclNode->m_ucFlags & TIMERLIST_FLAG_ONE_SHOT)
00193                 {
00194                     pclPrev = pclNode;
00195                 }
00196             }
00197             pclNode = static_cast<Timer*>(pclNode->GetNext());
00198 
00199             // Remove one-shot-timers
00200             if (pclPrev)
00201             {
00202                 Remove(pclPrev);
00203             }
00204         }
00205 
00206         // Check to see how much time has elapsed since the time we
00207         // acknowledged the interrupt...
```

```
00208         ulOvertime = KernelTimer::GetOvertime();
00209
00210         if( ulOvertime >= ulNewExpiry ) {
00211             m_ulNextWakeup = ulOvertime;
00212             bContinue = 1;
00213         }
00214
00215     // If it's taken longer to go through this loop than would take us to
00216     // the next expiry, re-run the timing loop
00217     } while (bContinue);
00218
00219
00220     // This timer elapsed, but there's nothing more to do...
00221     // Turn the timer off.
00222     if (ulNewExpiry >= MAX_TIMER_TICKS)
00223     {
00224         KernelTimer::Stop();
00225     }
00226     else
00227     {
00228         // Update the timer with the new "Next Wakeup" value, plus whatever
00229         // overtime has accumulated since the last time we called this handler
00230         m_ulNextWakeup = KernelTimer::SetExpiry(ulNewExpiry +
    ulOvertime);
00231     }
00232 }
00233
00234 //---------------------------------------------------------------------------
00235 void Timer::Start( K_UCHAR bRepeat_, K_ULONG ulIntervalMs_, TimerCallback_t pfCallback_, void *
    pvData_ )
00236 {
00237     SetIntervalMSeconds(ulIntervalMs_);
00238     m_pfCallback = pfCallback_;
00239     m_pvData = pvData_;
00240     if (!bRepeat_)
00241     {
00242         m_ucFlags = TIMERLIST_FLAG_ONE_SHOT;
00243     }
00244     else
00245     {
00246         m_ucFlags = 0;
00247     }
00248     m_pclOwner = Scheduler::GetCurrentThread();
00249     TimerScheduler::Add(this);
00250 }
00251
00252 //---------------------------------------------------------------------------
00253 void Timer::Stop()
00254 {
00255     TimerScheduler::Remove(this);
00256 }
00257
00258 //---------------------------------------------------------------------------
00259 void Timer::SetIntervalTicks( K_ULONG ulTicks_ )
00260 {
00261     m_ulInterval = ulTicks_;
00262 }
00263
00264 //---------------------------------------------------------------------------
00266 //---------------------------------------------------------------------------
00267 void Timer::SetIntervalSeconds( K_ULONG ulSeconds_)
00268 {
00269     m_ulInterval = SECONDS_TO_TICKS(ulSeconds_) - TL_FUDGE_FACTOR;
00270 }
00271
00272 //---------------------------------------------------------------------------
00273 void Timer::SetIntervalMSeconds( K_ULONG ulMSeconds_)
00274 {
00275     m_ulInterval = MSECONDS_TO_TICKS(ulMSeconds_) - TL_FUDGE_FACTOR;
00276 }
00277
00278 //---------------------------------------------------------------------------
00279 void Timer::SetIntervalUSeconds( K_ULONG ulUSeconds_)
00280 {
00281     m_ulInterval = USECONDS_TO_TICKS(ulUSeconds_) - TL_FUDGE_FACTOR;
00282 }
00283
00284 #endif //KERNEL_USE_TIMERS
```

14.179 /home/moslevin2/mark3/embedded/stage/src/timerlist.h File Reference

Timer list and timer-scheduling declarations.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "ll.h"
#include "thread.h"
```

Classes

- class Timer

  Timer - an event-driven execution context based on a specified time interval.
- class TimerList

  TimerList class - a doubly-linked-list of timer objects.
- class TimerScheduler

  "Static" Class used to interface a global TimerList with the rest of the kernel.

Macros

- #define TIMERLIST_FLAG_ONE_SHOT (0x01)

  Timer is one-shot.
- #define TIMERLIST_FLAG_ACTIVE (0x02)

  Timer is currently active.
- #define TIMERLIST_FLAG_CALLBACK (0x04)

  Timer is pending a callback.
- #define TIMERLIST_FLAG_EXPIRED (0x08)

  Timer is actually expired.
- #define MAX_TIMER_TICKS (0x7FFFFFFF)

  Maximum value to set.
- #define **SECONDS_TO_TICKS**(x) ((((K_ULONG)x) * TIMER_FREQ))
- #define **MSECONDS_TO_TICKS**(x) ((((((K_ULONG)x) * (TIMER_FREQ/100)) + 5) / 10))
- #define **USECONDS_TO_TICKS**(x) ((((((K_ULONG)x) * TIMER_FREQ) + 50000) / 1000000))
- #define MIN_TICKS (3)

  The minimum tick value to set.

Typedefs

- typedef void(* **TimerCallback_t**)(Thread *pclOwner_, void *pvData_)

14.179.1 Detailed Description

Timer list and timer-scheduling declarations. These classes implements a linked list of timer objects attached to the global kernel timer. Unlike other kernels which use a fully-synchronous "tick-based" timing mechanism, where the OS timing facilities are based on a fixed-frequency timer (which causes regular timer interrupts), Mark3 uses a "tickless" timer implementation, which only triggers interrupts when absolutely required. This is much more efficient in most cases - timer interrupts occur less frequently, allowing the kernel to stay in sleep much longer than it would otherwise.

Definition in file timerlist.h.

14.179.2 Macro Definition Documentation

14.179.2.1 #define TIMERLIST_FLAG_EXPIRED (0x08)

Timer is actually expired.

Definition at line 45 of file timerlist.h.

14.180 timerlist.h

```
00001 /*============================================================================
00002 
00003 
00004 
00005 
00006 
00007 
00008 
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010 
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ============================================================================*/
00030 #ifndef __TIMERLIST_H__
00031 #define __TIMERLIST_H__
00032 
00033 #include "kerneltypes.h"
00034 #include "mark3cfg.h"
00035 
00036 #include "ll.h"
00037 #include "thread.h"
00038 
00039 #if KERNEL_USE_TIMERS
00040 
00041 //---------------------------------------------------------------------------
00042 #define TIMERLIST_FLAG_ONE_SHOT         (0x01)
00043 #define TIMERLIST_FLAG_ACTIVE           (0x02)
00044 #define TIMERLIST_FLAG_CALLBACK         (0x04)
00045 #define TIMERLIST_FLAG_EXPIRED          (0x08)
00046 
00047 //---------------------------------------------------------------------------
00048 #define MAX_TIMER_TICKS                 (0x7FFFFFFF)
00049 
00050 //---------------------------------------------------------------------------
00051 /*
00052     Ugly macros to support a wide resolution of delays.
00053     Given a 16-bit timer @ 16MHz & 256 cycle prescaler, this gives us...
00054     Max time, SECONDS_TO_TICKS:  68719s
00055     Max time, MSECONDS_TO_TICKS: 6871.9s
00056     Max time, USECONDS_TO_TICKS: 6.8719s
00057      With a 16us tick resolution.
00058 */
00059 //---------------------------------------------------------------------------
00060 #define SECONDS_TO_TICKS(x)             ((((K_ULONG)x) * TIMER_FREQ))
00061 #define MSECONDS_TO_TICKS(x)            ((((((K_ULONG)x) * (TIMER_FREQ/100)) + 5) / 10))
00062 #define USECONDS_TO_TICKS(x)            ((((((K_ULONG)x) * TIMER_FREQ) + 50000) / 1000000))
00063 
00064 //---------------------------------------------------------------------------
00065 #define MIN_TICKS                       (3)
00066 //---------------------------------------------------------------------------
00067 typedef void (*TimerCallback_t)(Thread *pclOwner_, void *pvData_);
00068 
00069 //---------------------------------------------------------------------------
00070 class TimerList;
00071 class TimerScheduler;
00072 class Quantum;
00078 class Timer : public LinkListNode
00079 {
00080 public:
00084     Timer(){ m_ulInterval = 0; m_ulTimeLeft = 0;
      m_ucFlags = 0; }
00085 
00090     void Start( K_UCHAR bRepeat_, K_ULONG ulIntervalMs_, TimerCallback_t pfCallback_, void *pvData_ );
00091 
00096     void Stop();
00097 
00107     void SetFlags (K_UCHAR ucFlags_) { m_ucFlags = ucFlags_; }
00108 
00116     void SetCallback( TimerCallback_t pfCallback_){ m_pfCallback = pfCallback_; }
00117 
00125     void SetData( void *pvData_ ){ m_pvData = pvData_; }
```

```
00126
00135     void SetOwner( Thread *pclOwner_){ m_pclOwner = pclOwner_; }
00136
00144     void SetIntervalTicks(K_ULONG ulTicks_);
00145
00153     void SetIntervalSeconds(K_ULONG ulSeconds_);
00154
00162     void SetIntervalMSeconds(K_ULONG ulMSeconds_);
00163
00171     void SetIntervalUSeconds(K_ULONG ulUSeconds_);
00172
00173 private:
00174
00175     friend class TimerList;
00176
00178     K_UCHAR m_ucFlags;
00179
00181     TimerCallback_t m_pfCallback;
00182
00184     K_ULONG m_ulInterval;
00185
00187     K_ULONG m_ulTimeLeft;
00188
00190     Thread  *m_pclOwner;
00191
00193     void    *m_pvData;
00194 };
00195
00196 //---------------------------------------------------------------------------
00200 class TimerList : public DoubleLinkList
00201 {
00202 public:
00209     void Init();
00210
00218     void Add(Timer *pclListNode_);
00219
00227     void Remove(Timer *pclListNode_);
00228
00235     void Process();
00236
00237 private:
00239     K_ULONG m_ulNextWakeup;
00240
00242     K_UCHAR m_bTimerActive;
00243 };
00244
00245 //---------------------------------------------------------------------------
00250 class TimerScheduler
00251 {
00252 public:
00259     static void Init() { m_clTimerList.Init(); }
00260
00269     static void Add(Timer *pclListNode_)
00270         {m_clTimerList.Add(pclListNode_); }
00271
00280     static void Remove(Timer *pclListNode_)
00281         {m_clTimerList.Remove(pclListNode_); }
00282
00291     static void Process() {m_clTimerList.Process();}
00292 private:
00293
00295     static TimerList m_clTimerList;
00296 };
00297
00298 #endif // KERNEL_USE_TIMERS
00299
00300 #endif
```

14.181 /home/moslevin2/mark3/embedded/stage/src/tracebuffer.cpp File Reference

Kernel trace buffer class definition.

```
#include "kerneltypes.h"
#include "tracebuffer.h"
#include "mark3cfg.h"
#include "writebuf16.h"
#include "kernel_debug.h"
```

14.181.1 Detailed Description

Kernel trace buffer class definition.

Definition in file tracebuffer.cpp.

14.182 tracebuffer.cpp

```
00001 /*============================================================================
00002      _____        _____        _____        _____
00003  ___|    _|__  __|_    |__  __|__   |__  __| __  |__  ______
00004 |    \  /  | ||    \       ||      |     ||  |/ /     ||___   |
00005 |     \/   | ||     \      ||      \     ||     \     ||___   |
00006 |__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
00007     |_____|      |_____|      |_____|      |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ============================================================================*/
00019 #include "kerneltypes.h"
00020 #include "tracebuffer.h"
00021 #include "mark3cfg.h"
00022 #include "writebuf16.h"
00023 #include "kernel_debug.h"
00024
00025 #if KERNEL_USE_DEBUG
00026
00027 //---------------------------------------------------------------------------
00028 WriteBuffer16 TraceBuffer::m_clBuffer;
00029 volatile K_USHORT TraceBuffer::m_usIndex;
00030 K_USHORT TraceBuffer::m_ausBuffer[ (TRACE_BUFFER_SIZE/sizeof(K_USHORT)) ];
00031
00032 //---------------------------------------------------------------------------
00033 void TraceBuffer::Init()
00034 {
00035     m_clBuffer.SetBuffers(m_ausBuffer, TRACE_BUFFER_SIZE/sizeof(K_USHORT));
00036     m_usIndex = 0;
00037 }
00038
00039 //---------------------------------------------------------------------------
00040 K_USHORT TraceBuffer::Increment()
00041 {
00042     return m_usIndex++;
00043 }
00044
00045 //---------------------------------------------------------------------------
00046 void TraceBuffer::Write( K_USHORT *pusData_, K_USHORT usSize_ )
00047 {
00048     // Pipe the data directly to the circular buffer
00049     m_clBuffer.WriteData(pusData_, usSize_);
00050 }
00051
00052 #endif
00053
```

14.183 /home/moslevin2/mark3/embedded/stage/src/tracebuffer.h File Reference

Kernel trace buffer class declaration.

```
#include "kerneltypes.h"
#include "mark3cfg.h"
#include "writebuf16.h"
```

14.183.1 Detailed Description

Kernel trace buffer class declaration. Global kernel trace-buffer. Used to instrument the kernel with lightweight encoded print statements. If something goes wrong, the tracebuffer can be examined for debugging purposes. Also,

subsets of kernel trace information can be extracted and analyzed to provide information about runtime performance, thread-scheduling, and other nifty things in real-time.

Definition in file tracebuffer.h.

14.184 tracebuffer.h

```
00001 /*=====================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__   ___|_    |__   ___|__   |__   ___| __  |__   ______
00004 |    \   /   | ||     \       ||       |      ||   |/ /      ||___   |
00005 |     \/    | ||      \      ||       \      ||      \      ||___   |
00006 |__/\__/|__|_||__|\__\  ___||__|\__\  ___||__|\__\  ___||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 =====================================================================*/
00024 #ifndef __TRACEBUFFER_H__
00025 #define __TRACEBUFFER_H__
00026
00027 #include "kerneltypes.h"
00028 #include "mark3cfg.h"
00029 #include "writebuf16.h"
00030
00031 #if KERNEL_USE_DEBUG
00032
00033 #define TRACE_BUFFER_SIZE           (16)
00034
00038 class TraceBuffer
00039 {
00040 public:
00046     static void Init();
00047
00055     static K_USHORT Increment();
00056
00065     static void Write( K_USHORT *pusData_, K_USHORT usSize_ );
00066
00075     void SetCallback( WriteBufferCallback pfCallback_ )
00076         { m_clBuffer.SetCallback( pfCallback_ ); }
00077 private:
00078
00079     static WriteBuffer16 m_clBuffer;
00080     static volatile K_USHORT m_usIndex;
00081     static K_USHORT m_ausBuffer[ (TRACE_BUFFER_SIZE / sizeof( K_USHORT )) ];
00082 };
00083
00084 #endif //KERNEL_USE_DEBUG
00085
00086 #endif
```

14.185 /home/moslevin2/mark3/embedded/stage/src/unit_test.cpp File Reference

Unit test class definition.

```
#include "kerneltypes.h"
#include "unit_test.h"
```

14.185.1 Detailed Description

Unit test class definition.

Definition in file unit_test.cpp.

14.186 unit_test.cpp

```
00001 /*=============================================================================
00002       _____          _____          _____          _____
00003  ____|    _|__   ___|_    |__   ___|__    |__   ___| __  |__   ______
00004 |    \   /   | ||     \       ||      |     ||   |/ /      ||___    |
00005 |     \/    | ||      \      ||      \     ||     \       ||___    |
00006 |__/\__/|__|_||__|\__\   __||__|\__\   __||__|\__\   __||______|
00007     |_____|       |_____|       |_____|       |_____|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 ===========================================================================*/
00019 #include "kerneltypes.h"
00020 #include "unit_test.h"
00021
00022 //---------------------------------------------------------------------------
00023 UnitTest::UnitTest()
00024 {
00025     m_bIsActive = false;
00026     m_usIterations = 0;
00027     m_usPassed = 0;
00028     m_bComplete = false;
00029 }
00030
00031 //---------------------------------------------------------------------------
00032 void UnitTest::Pass()
00033 {
00034     if (m_bComplete)
00035     {
00036         return;
00037     }
00038
00039     if (m_bIsActive)
00040     {
00041         m_bIsActive = false;
00042         m_usIterations++;
00043         m_usPassed++;
00044         m_bStatus = true;
00045     }
00046 }
00047
00048 //---------------------------------------------------------------------------
00049 void UnitTest::Fail()
00050 {
00051     if (m_bComplete)
00052     {
00053         return;
00054     }
00055
00056     if (m_bIsActive)
00057     {
00058         m_bIsActive = false;
00059         m_usIterations++;
00060         m_bStatus = false;
00061     }
00062 }
```

14.187 /home/moslevin2/mark3/embedded/stage/src/unit_test.h File Reference

Unit test class declarations.

```
#include "kerneltypes.h"
```

Classes

- class UnitTest

  Class used to implement a simple unit-testing framework.

14.187.1 Detailed Description

Unit test class declarations.

Definition in file unit_test.h.

14.188 unit_test.h

```
/*===========================================================================
     _____        _____        _____        _____
 ___|    _|__  __|_    |__  __|__   |__  __| __  |__  ______
|    \  /  | ||    \      ||     |     ||  |/ /     ||___   |
|     \/   | ||     \     ||     \     ||     \     ||___   |
|__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
    |_____|      |_____|      |_____|      |_____|

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===========================================================================*/
#ifndef __UNIT_TEST_H__
#define __UNIT_TEST_H__


#include "kerneltypes.h"

//---------------------------------------------------------------------------
class UnitTest
{
public:
    UnitTest();

    void SetName( const K_CHAR *szName_ ) { m_szName = szName_; }

    void Start() { m_bIsActive = 1; }

    void Pass();

    void Fail();

    void ExpectTrue( bool bExpression_ )
        { bExpression_ ? Pass() : Fail(); }

    void ExpectFalse( bool bExpression_ )
        { !bExpression_ ? Pass() : Fail(); }

    void ExpectEquals( bool bVal_, bool bExpression_ )
        { (bVal_ == bExpression_) ? Pass() : Fail(); }

    void ExpectEquals( K_UCHAR ucVal_, K_UCHAR ucExpression_ )
        { (ucVal_ == ucExpression_) ? Pass() : Fail(); }

    void ExpectEquals( K_USHORT usVal_, K_USHORT usExpression_ )
        { (usVal_ == usExpression_) ? Pass() : Fail(); }

    void ExpectEquals( K_ULONG ulVal_, K_ULONG ulExpression_ )
        { (ulVal_ == ulExpression_) ? Pass() : Fail(); }

    void ExpectEquals( K_CHAR cVal_, K_CHAR cExpression_ )
        { (cVal_ == cExpression_) ? Pass() : Fail(); }

    void ExpectEquals( K_SHORT sVal_, K_SHORT sExpression_ )
        { (sVal_ == sExpression_) ? Pass() : Fail(); }

    void ExpectEquals( K_LONG lVal_, K_LONG lExpression_ )
        { (lVal_ == lExpression_) ? Pass() : Fail(); }

    void ExpectEquals( void* pvVal_, void* pvExpression_ )
        { (pvVal_ == pvExpression_) ? Pass() : Fail(); }


    void ExpectFailTrue( bool bExpression_ )
        { bExpression_ ? Fail() : Pass(); }

    void ExpectFailFalse( bool bExpression_ )
        { !bExpression_ ? Fail() : Pass(); }

    void ExpectFailEquals( bool bVal_, bool bExpression_ )
        { (bVal_ == bExpression_) ? Fail() : Pass(); }

    void ExpectFailEquals( K_UCHAR ucVal_, K_UCHAR ucExpression_ )
```

```
00107         { (ucVal_ == ucExpression_) ? Fail() : Pass(); }
00108
00109     void ExpectFailEquals( K_USHORT usVal_, K_USHORT usExpression_ )
00110         { (usVal_ == usExpression_) ? Fail() : Pass(); }
00111
00112     void ExpectFailEquals( K_ULONG ulVal_, K_ULONG ulExpression_ )
00113         { (ulVal_ == ulExpression_) ? Fail() : Pass(); }
00114
00115     void ExpectFailEquals( K_CHAR cVal_, K_CHAR cExpression_ )
00116         { (cVal_ == cExpression_) ? Fail() : Pass(); }
00117
00118     void ExpectFailEquals( K_SHORT sVal_, K_SHORT sExpression_ )
00119         { (sVal_ == sExpression_) ? Fail() : Pass(); }
00120
00121     void ExpectFailEquals( K_LONG lVal_, K_LONG lExpression_ )
00122         { (lVal_ == lExpression_) ? Fail() : Pass(); }
00123
00124     void ExpectFailEquals( void* pvVal_, void* pvExpression_ )
00125         { (pvVal_ == pvExpression_) ? Fail() : Pass(); }
00126
00127     void ExpectGreaterThan( K_LONG lVal_, K_LONG lExpression_ )
00128         { (lVal_ > lExpression_) ? Pass() : Fail(); }
00129
00130     void ExpectLessThan( K_LONG lVal_, K_LONG lExpression_ )
00131         { (lVal_ < lExpression_) ? Pass() : Fail(); }
00132
00133     void ExpectGreaterThanEquals( K_LONG lVal_, K_LONG lExpression_ )
00134         { (lVal_ >= lExpression_) ? Pass() : Fail(); }
00135
00136     void ExpectLessThanEquals( K_LONG lVal_, K_LONG lExpression_ )
00137         { (lVal_ <= lExpression_) ? Pass() : Fail(); }
00138
00139     void ExpectFailGreaterThan( K_LONG lVal_, K_LONG lExpression_ )
00140         { (lVal_ > lExpression_) ? Fail() : Pass(); }
00141
00142     void ExpectFailLessThan( K_LONG lVal_, K_LONG lExpression_ )
00143         { (lVal_ < lExpression_) ? Fail() : Pass(); }
00144
00145     void ExpectFailGreaterThanEquals( K_LONG lVal_, K_LONG lExpression_ )
00146         { (lVal_ >= lExpression_) ? Fail() : Pass(); }
00147
00148     void ExpectFailLessThanEquals( K_LONG lVal_, K_LONG lExpression_ )
00149         { (lVal_ <= lExpression_) ? Fail() : Pass(); }
00150
00157     void Complete() { m_bComplete = 1; }
00158
00166     const K_CHAR *GetName(){ return m_szName; }
00167
00175     K_BOOL GetResult() { return m_bStatus; }
00176
00184     K_USHORT GetPassed() { return m_usPassed; }
00185
00193     K_USHORT GetFailed() { return m_usIterations -
      m_usPassed; }
00194
00202     K_USHORT GetTotal() { return m_usIterations; }
00203
00204 private:
00205     const K_CHAR *m_szName;
00206     K_BOOL m_bIsActive;
00207     K_UCHAR m_bComplete;
00208     K_BOOL m_bStatus;
00209     K_USHORT m_usIterations;
00210     K_USHORT m_usPassed;
00211 };
00212
00213 #endif
```

14.189 /home/moslevin2/mark3/embedded/stage/src/writebuf16.cpp File Reference

16 bit circular buffer implementation with callbacks.

```
#include "kerneltypes.h"
#include "writebuf16.h"
#include "kernel_debug.h"
#include "threadport.h"
```

14.189.1 Detailed Description

16 bit circular buffer implementation with callbacks.

Definition in file writebuf16.cpp.

14.190 writebuf16.cpp

```
00001 /*=========================================================================
00002      ______          ______          ______          ______
00003  ___|     _|__   __|_     |__   __|__     |__   __| __   |__   ______
00004 |     \   /   | ||     \       ||      |      ||   |/ /      ||___    |
00005 |      \/     | ||      \      ||      \      ||      \      ||___    |
00006 |__/\__/|__|_||__|\__\   __||__|\__\   __||__|\__\   __||______|
00007     |______|       |______|       |______|       |______|
00008
00009 --[Mark3 Realtime Platform]----------------------------------------------
00010
00011 Copyright (c) 2012 Funkenstein Software Consulting, all rights reserved.
00012 See license.txt for more information
00013 =========================================================================*/
00020 #include "kerneltypes.h"
00021 #include "writebuf16.h"
00022 #include "kernel_debug.h"
00023 #include "threadport.h"
00024 //---------------------------------------------------------------------------
00025 void WriteBuffer16::WriteData( K_USHORT *pusBuf_, K_USHORT usLen_ )
00026 {
00027     K_USHORT *apusBuf[1];
00028     K_USHORT ausLen[1];
00029
00030     apusBuf[0] = pusBuf_;
00031     ausLen[0] = usLen_;
00032
00033     WriteVector( apusBuf, ausLen, 1 );
00034 }
00035
00036 //---------------------------------------------------------------------------
00037 void WriteBuffer16::WriteVector( K_USHORT **ppusBuf_, K_USHORT *pusLen_, K_UCHAR
      ucCount_ )
00038 {
00039     K_USHORT usTempHead;
00040     K_UCHAR i;
00041     K_UCHAR j;
00042     K_USHORT usTotalLen = 0;
00043     bool bCallback = false;
00044     bool bRollover = false;
00045     // Update the head pointer synchronously, using a small
00046     // critical section in order to provide thread safety without
00047     // compromising on responsiveness by adding lots of extra
00048     // interrupt latency.
00049
00050     CS_ENTER();
00051
00052     usTempHead = m_usHead;
00053     {
00054         for (i = 0; i < ucCount_; i++)
00055         {
00056             usTotalLen += pusLen_[i];
00057         }
00058         m_usHead = (usTempHead + usTotalLen) % m_usSize;
00059     }
00060     CS_EXIT();
00061
00062     // Call the callback if we cross the 50% mark or rollover
00063     if (m_usHead < usTempHead)
00064     {
00065         if (m_pfCallback)
00066         {
00067             bCallback = true;
00068             bRollover = true;
00069         }
00070     }
00071     else if ((usTempHead < (m_usSize >> 1)) && (m_usHead >= (
      m_usSize >> 1)))
00072     {
00073         // Only trigger the callback if it's non-null
00074         if (m_pfCallback)
00075         {
00076             bCallback = true;
00077         }
00078     }
```

```
00079
00080     // Are we going to roll-over?
00081     for (j = 0; j < ucCount_; j++)
00082     {
00083         K_USHORT usSegmentLength = pusLen_[j];
00084         if (usSegmentLength + usTempHead >= m_usSize)
00085         {
00086             // We need to two-part this... First part: before the rollover
00087             K_USHORT usTempLen;
00088             K_USHORT *pusTmp = &m_pusData[ usTempHead ];
00089             K_USHORT *pusSrc = ppusBuf_[j];
00090             usTempLen = m_usSize - usTempHead;
00091             for (i = 0; i < usTempLen; i++)
00092             {
00093                 *pusTmp++ = *pusSrc++;
00094             }
00095
00096             // Second part: after the rollover
00097             usTempLen = usSegmentLength - usTempLen;
00098             pusTmp = m_pusData;
00099             for (i = 0; i < usTempLen; i++)
00100             {
00101                 *pusTmp++ = *pusSrc++;
00102             }
00103         }
00104         else
00105         {
00106             // No rollover - do the copy all at once.
00107             K_USHORT *pusSrc = ppusBuf_[j];
00108             K_USHORT *pusTmp = &m_pusData[ usTempHead ];
00109             for (K_USHORT i = 0; i < usSegmentLength; i++)
00110             {
00111                 *pusTmp++ = *pusSrc++;
00112             }
00113         }
00114     }
00115
00116
00117     // Call the callback if necessary
00118     if (bCallback)
00119     {
00120         if (bRollover)
00121         {
00122             // Rollover - process the back-half of the buffer
00123             m_pfCallback( &m_pusData[ m_usSize >> 1],
      m_usSize >> 1 );
00124         }
00125         else
00126         {
00127             // 50% point - process the front-half of the buffer
00128             m_pfCallback( m_pusData, m_usSize >> 1);
00129         }
00130     }
00131 }
```

14.191 /home/moslevin2/mark3/embedded/stage/src/writebuf16.h File Reference

Thread-safe circular buffer implementation with 16-bit elements.

```
#include "kerneltypes.h"
```

Classes

- class WriteBuffer16

  This class is used to provide a general-purpose, fully thread-safe circular buffer implementation which can be used for creating tracebuffers, data logging queues, transaction queues, etc.

Typedefs

- typedef void(∗ WriteBufferCallback)(K_USHORT ∗pusData_, K_USHORT usSize_)

  Function pointer type used to define a callback handler for when the circular buffer reaches 50% capacity,.

14.191.1 Detailed Description

Thread-safe circular buffer implementation with 16-bit elements.

Definition in file writebuf16.h.

14.192 writebuf16.h

```
/*===========================================================================
     _____        _____        _____        _____
 ___|    _|__  __|_    |__  __|__   |__  __| __  |__  ______
|    \  /  | ||    \      ||     |     ||  |/ /     ||___   |
|     \/   | ||     \     ||     \     ||     \     ||___   |
|__/\__/|__|_||__|\__\  __||__|\__\  __||__|\__\  __||______|
    |_____|      |_____|      |_____|      |_____|

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===========================================================================*/
#ifndef __WRITEBUF16_H__
#define __WRITEBUF16_H__

#include "kerneltypes.h"

typedef void (*WriteBufferCallback)( K_USHORT *pusData_, K_USHORT usSize_ );

class WriteBuffer16
{
public:
    void SetBuffers( K_USHORT *pusData_, K_USHORT usSize_ )
    {
        m_pusData = pusData_;
        m_usSize = usSize_;
        m_usHead = 0;
        m_usTail = 0;
    }

    void SetCallback( WriteBufferCallback pfCallback_ )
        { m_pfCallback = pfCallback_; }

    void WriteData( K_USHORT *pusBuf_, K_USHORT usLen_ );

    void WriteVector( K_USHORT **ppusBuf_, K_USHORT *pusLen_, K_UCHAR ucCount_);

private:
    K_USHORT *m_pusData;

    volatile K_USHORT m_usSize;
    volatile K_USHORT m_usHead;
    volatile K_USHORT m_usTail;

    WriteBufferCallback m_pfCallback;
};

#endif
```

Index