THREADX®: ADVANCED, SMALL, FAST

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THREADX RTOS

The ThreadX® Real-Time Operating System is a highly efficient, robust, royalty-free kernel designed for deeply embedded applications requiring a small footprint and rapid real-time response. ThreadX provides super-fast context switching while offering developers a rich set of services to use for task control and communication. ThreadX is fully integrated with the Green Hills Software MULTI® 2000 Integrated Development Environment, providing Optimizing Compilers, Source Debugger, Graphical Project Builder and many other powerful tools for development of embedded applications.

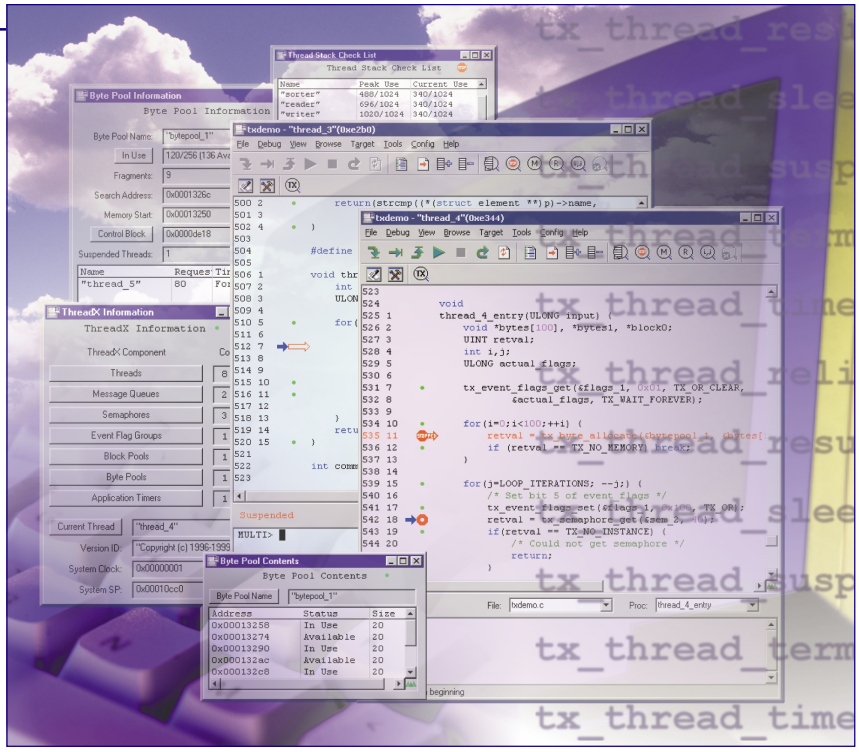
THREADX IS ADVANCED

- Simple, non-layered, *picokernel* design that is the result of 18 years of embedded RTOS experience.
- **Preemption-Threshold**, a new technique that reduces context-switching and provides responsiveness in critical sections. Preemption-threshold marries the best of preemptive and non-preemptive real-time scheduling and is a major subject of academic research. Here are links to the latest preemption-threshold research papers:

  http://www.cs.pitt.edu/~manas/papers/wang.pdf

  http://www.cs.pitt.edu/~manas/papers/rtcsa99.pdf

- Efficient software timers, activated and deactivated via direct indexing, with no linear search algorithms.
- API objects (threads, timers, queues, semaphores, event flags, and memory pools) easily located in any memory area at run-time.
- Easy to combine objects into hybrid objects that new hybrid services can manipulate.



WHAT ABOUT THE COMPETITION?

No other RTOS company has preemption-threshold technology or other advanced technology in ThreadX.

WHAT MAKES THREADX SOURCE CODE SO GREAT?

- Component design methodology where each internal ThreadX component has a distinct API in itself. This results in a modular, highly reliable end product.
- Simple naming conventions that show the component and purpose of all global variables and function names. All global symbols start with "_tx" so they do not intrude into the application's name space. In addition, the component name comes before the symbol's meaning, which results in a grouping of component symbols.
- Documented source code conventions along with a description of each ThreadX component are found in Chapter 7 of the **ThreadX User Guide**.

WHAT MAKES THREADX SO PORTABLE?

ThreadX is available for more than twenty of today's leading embedded microprocessor families. Why? The processor specific portions of ThreadX are isolated to one include file (tx_port.h), and eight assembly language functions. Because of this, new processor ports can be completed in a matter of weeks, which helps protect the application's processor portability.

THREADX IS SMALL

- Implemented as a C library; only the ThreadX objects that are used by the application are brought into the final image. For example, if your application doesn't use *tx_semaphore_delete*, its corresponding object will not be taking up space in your final image.

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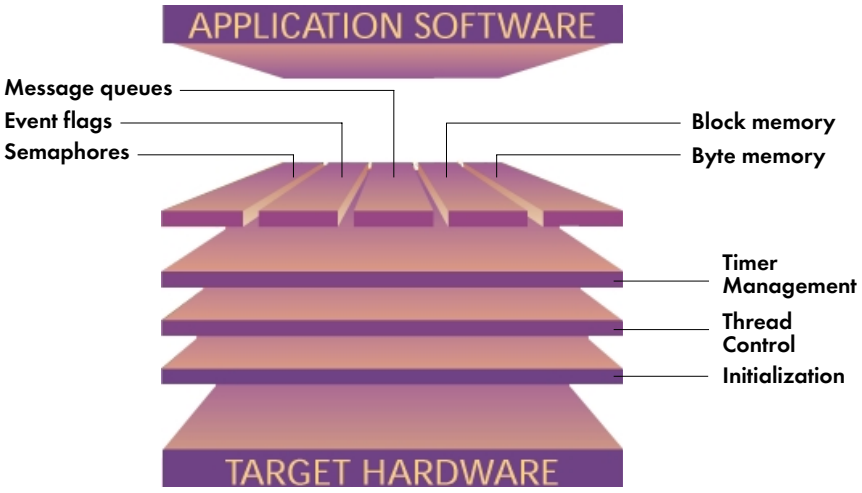
- Extremely small minimal footprint for basic round-robin scheduling, only the following ThreadX files are needed:
  tx_ill.s ..... Initialize low-level
  tx_ike.c ..... Initialize kernel entry
  tx_ihl.c ..... Initialize high-level
  tx_ti.c ..... Thread initialize
  tx_tc.c ..... Thread create
  tx_ts.s ..... Thread schedule
  tx_tsb.s ..... Thread stack build
  tx_tse.c ..... Thread shell entry
  tx_tsr.s ..... Thread system return
  tx_tr.c ..... Thread resume
  tx_trel.c ..... Thread relinquish
- System stack used for ISR processing, keeping thread stacks minimal in size.
- As much as EIGHT times smaller than VxWorks™. Customer measured VxWorks at ~40KBytes, while ThreadX ranged from 5-25KBytes.
- As much as 50% smaller than Nucleus PLUS™. Nucleus PLUS ranges from 8K to about 35K on PowerPC architectures.

ThreadX Is Fast

- Flat API function call implementation for immediate response conditions.
- Compiler in-line assembly used for internal ThreadX protection.
- Solicited context switching (switches from within the API) save only the compiler preserved registers.
- No context saving or restoring for interrupts that occur in idle system.
- Only compiler scratch registers saved on the front end of ISR processing. Remaining registers saved only if preemption is required.
- Ability to conditionally disable some of the basic API error checking once the application is debugged.
- Extensive use of processor features such as delay slots, memory alignment, and extra register banks.
- Advanced technology like preemption-threshold to help reduce context switching.
- Fast software timers that are activated and deactivate in a direct index manner - no linear searches.
- As much as FIVE times faster than VxWorks, on a 40MHz 860, customer measured VxWorks at 54.8us and ThreadX at 11.1us for queue/context switch time.
- As much as 45% faster than Nucleus PLUS on 40Mhz 860. ThreadX interrupt processing is FIVE times faster than Nucleus PLUS.



Sales and Support

Green Hills Software, Inc.
Corporate Headquarters
30 West Sola Street
Santa Barbara, California 93101
T: 805.965.6044 ▪ F: 805.965.6343
Email: sales@ghs.com ▪ www.ghs.com

North America
California - Cupertino
T: 408.873.4930 ▪ F: 408.873.4933

California - San Clemente
T: 949.369.3950 ▪ F: 949.369.3959

California - Scotts Valley
T: 831.430.0525 ▪ F: 831.430.0415

Colorado - Denver
T: 303.740.8462 ▪ F: 303.740.8468

Illinois - Chicago
T: 847.515.2418 ▪ F: 847.515.2429

Massachusetts - Lexington
T: 781.862.2002 ▪ F: 781.863.2633

North Carolina - Mars Hill
T: 828.689.8508 ▪ F: 828.273.0475

Texas - Dallas
T: 972.733.6505 ▪ F: 972.733.6504

North American Ada Sales
California - Laguna Hills
T: 949.460.6442 ▪ F: 949.460.6443

Florida - Palm Harbor
T: 727.781.4909 ▪ F: 727.781.3915

International Offices
United Kingdom
European Headquarters
T: +44.1494.429336
F: +44.1494.429339

France
T: +33.1.46.96.07.00
F: +33.1.46.96.07.07

Germany
T: +49.721.98.62.580
F: +49.721.98.62.581

Japan (ADaC)
T: +81.3.3576.5351
F: +81.3.3576.1772

Netherlands
T: +31.33.4613363
F: +31.33.4613640

Scandinavia
T: +46.46.211.33.70
F: +46.46.37.35.90

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