expresslogic
When It Really Counts!
Express Logic, Inc., is a San Diego, CA based developer of real-time operating systems (RTOS) and related products for embedded applications. Founded in 1996, Express Logic has consistently led the industry with high-value software products and responsive, reliable customer support.

Express Logic was founded by William E. (Bill) Lamie and David L. Lamie. Self-funded and privately operated since its inception, Express Logic operates from its San Diego, CA headquarters, with offices and representatives worldwide.

Express Logic’s products include the popular ThreadX® real-time operating system (RTOS), NetX™ TCP/IP stack, FileX® embedded file system, USBX™ host/device USB stack, GUIX® embedded GUI development kit, StackX™ stack size analyzer, and TraceX® graphical real-time event trace utility.

Mobile Deployments
Express Logic’s ThreadX® RTOS has been deployed in over 1.5 Billion electronic products, spanning a variety of markets. Among those are over a billion mobile devices, twice the milestone recently recognized by VisionMobile in their semi-annual survey of mobile device deployments. VisionMobile, a market analysis and strategy firm delivering market know-how to the mobile industry, offers research reports, industry maps, training courses and advisory services on emerging technologies.

“We welcome Express Logic into the 100 Million Club based on the widespread use of their ThreadX RTOS product in mobile devices,” commented Andreas Constantinou, Research Director of VisionMobile. “ThreadX already has amassed over 500 million mobile deployments and represents one of a small number of software products that can claim such success.”

Fast Time to Market
Another survey, conducted annually by Embedded Market Forecasters, shows that developers who used ThreadX reported that they completed their development projects on-time or ahead of schedule more often than those using other RTOSes – including Linux – over 70% of the time! Use ThreadX and get YOUR next product to market faster.

Get Our Newsletter
Express Logic publishes informative Newsletters with the latest product introductions, technology spotlight, and related industry news. To receive this free newsletter, visit www.rtos.com/downloads, and look for the link to Opt-In.
Who is using our Products?

Markets Served

It’s no surprise that over 1.5 billion embedded devices have been deployed using ThreadX, and more are on the way at a rate of over 400 million per year! These devices are found in high-volume market areas such as consumer electronics, medical devices, and industrial automation equipment. Our web site has a sampling of customer testimonials from each of these areas.

- Consumer Devices. With hundreds of million consumer devices powered by Express Logic’s ThreadX RTOS, NetX TCP/IP networking stack, and FileX file system, Express Logic outpaces all other suppliers to consumer device development.

- Medical Devices. From hand-held diagnostic equipment to respirators and ventilators, Express Logic products meet the needs of medical device manufacturers, and the requirements of FDA certification.

- Networking. From wireless, hand-held devices to cell phones, to DSL routers, Express Logic’s products are ideal for high-performance data networking applications.

- System-On-Chip (SoC) manufacturers increasingly turn to Express Logic’s ThreadX for its small, fast and royalty-free benefits. Express Logic enables SoC development with the fastest time-to-market and lowest possible cost.

- Industrial Automation/Automotive. Express Logic delivers cost-effective solutions for industrial automation and automotive applications.

- Aerospace/Defense. Developers employ Express Logic’s products because of their small memory footprint, ease of use, and ease of certification for demanding FAA applications.

Partners

Express Logic is extremely proud to have many industry leading partners who provide technologies that complement our own products. From development tools, to communications middleware, to microprocessors, and more, Express Logic’s partners form an ecosystem that enables developers to choose ThreadX-compatible, integrated, and supported products to complete their needs.

Business Model

Express Logic’s business model is based on a royalty-free approach. We do not charge per-unit fees for deployed units. Instead, we charge for licenses that authorize the use of ThreadX in the development and production of individual, or a family of products. In all cases, full ThreadX source code is provided, and direct telephone, e-mail, and in-person support is available for an annual fee.

Representative ThreadX Deployments

<table>
<thead>
<tr>
<th>Product Category</th>
<th>ThreadX Deployments</th>
<th>Representative Customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wireless Networking</td>
<td>1,000,000,000</td>
<td>Broadcom, Intel, Marvell</td>
</tr>
<tr>
<td>Ink-Jet Printers</td>
<td>425,000,000</td>
<td>HP, Sharp</td>
</tr>
<tr>
<td>Baseboard Management Controllers</td>
<td>50,000,000</td>
<td>Intel, QLogic</td>
</tr>
<tr>
<td>Cell Phones</td>
<td>30,000,000</td>
<td>Samsung, Infineon, Datang</td>
</tr>
<tr>
<td>Digital TV</td>
<td>18,000,000</td>
<td>Sony, Pioneer, Zoran</td>
</tr>
<tr>
<td>Digital Cameras</td>
<td>18,000,000</td>
<td>HP, Pentax, Zoran</td>
</tr>
<tr>
<td>DVD Recorders/Players</td>
<td>7,250,000</td>
<td>Toshiba, Sharp, Zoran</td>
</tr>
<tr>
<td>Storage Devices</td>
<td>3,750,000</td>
<td>ST, Quantum</td>
</tr>
<tr>
<td>DSL/Cable Modems</td>
<td>3,200,000</td>
<td>Conklin</td>
</tr>
<tr>
<td>Medical Devices</td>
<td>2,500,000</td>
<td>Welch-Allyn</td>
</tr>
<tr>
<td>Digital Radio</td>
<td>2,000,000</td>
<td>IBiquity</td>
</tr>
<tr>
<td>Space Probes</td>
<td>2</td>
<td>NASA</td>
</tr>
</tbody>
</table>

This chart shows an approximate breakdown of more than 1.5 billion devices into product categories such as wireless devices (bluetooth, baseband radio, WiFi), Printers, Cameras, Digital TV, and the like. You can see the types of products most widely developed using ThreadX, and some representative customers who make those products.

Hewlett Packard has licensed the use of ThreadX for all Inkjet and all-in-one devices.

Zoran uses ThreadX in its SoCs for digital cameras, printing, television, and other consumer electronic devices.

ThreadX is widely used in networking controlling Bluetooth and Baseband Radios in cell phones.

Welch Allyn uses ThreadX in a wide range of its medical equipment, including defibrillators, blood analyzers, and monitors.

Pulmonetic Systems uses ThreadX in ventilators that keep paralyzed patients supplied with life-critical oxygen.

ThreadX is used in the automotive industry in a number of applications, including test equipment and digital radios.

In November, 2006, the Mars Reconnaissance Orbiter (MRO) entered an orbit around Mars and began taking spectacular high-resolution images of the Red Planet.
ThreadX is a real-time operating system (RTOS) designed for embedded, real-time applications running on microcontrollers, microprocessors, or DSPs.

**THREADX Snapshot**
- Small-footprint (small as 2KB, automatic scaling)
- Fast execution (sub microsecond context switch)
- Supports all popular processors and tools (see below)
- TraceX system analysis support
- Advanced technology:
  - Preemption-Threshold™
  - Performance metrics
  - Run-time and Static Stack Analysis
  - Downloadable Application Modules
- Extensive ThreadX ecosystem
- Safety-critical Certification Pack™
- Deployed in over 1.5 Billion devices
- Full Source Code
- Royalty-Free

**Fast Time To Market**
ThreadX is easy to install, learn, use, debug, verify, certify and maintain, for multiple reasons:

1. **Source Code Availability** - including kernel
2. **Easy-to-use API** - speeds programming and minimizes errors
3. **Quickly Migrate Legacy Code** - POSIX, uITRON, OSEK APIs

**Low Cost**
ThreadX is licensed royalty-free, for the lowest possible manufacturing cost. ThreadX is Field Proven, lowering support costs. Proven reliability in over 1 billion deployments dramatically lowers support costs.

**Small Size**
ThreadX is small in size, as small as 2KB ROM, so it can fit within even the most demanding memory size constraints imaginable. Only those services used by the application are linked into the final image.

**High Performance**
ThreadX delivers the highest performance found in commercial real-time operating systems, significantly faster than other RTOSes.

- **Fast Boot.** ThreadX boots in less than 120 cycles
- **Optional Removal of basic error checking.** Basic ThreadX error checking can be skipped at a compile-time
- **Picokernel™ Design,** with services not layered on each other
- **Optimized Interrupt Processing.** Only scratch registers are saved/restored upon ISR entry/exit, unless preemption is necessary.
- **Fast Interrupt Response Time, Fast Context Switching,** Low RTOS Service Overhead.

**ThreadX Service** | **Service Time**
--- | ---
Thread Suspend | 0.6us
Thread Resume | 0.6us
Queue Send | 0.3us
Queue Receive | 0.3us
Get Semaphore | 0.2us
Put Semaphore | 0.2us
Context Switch | 0.4us
Interrupt Response | 0.0us - 0.6us

**ThreadX Services** | **Typical Size In Bytes**
--- | ---
Core Services (required) | 2,000
Queue Services | 900
Event Flag Services | 900
Semaphore Services | 450
Mutex Services | 1,200
Block Memory Services | 550
Byte Memory Services | 900

Based on 200MHz processor

**Memory Protection**
ThreadX enables application threads and the ThreadX kernel to be protected against accidental read or write access from other threads. This prevents code or data corruption from latent application bugs, and eliminates one of the most common causes of application crashes.

**Downloadable Application Modules**
ThreadX enables one or more application threads to be bundled into a “Module” that can be dynamically loaded and run on the target. Modules enable field upgrade, bug fixing, and program partitioning to allow large applications to occupy only the memory needed by active threads.
ThreadX Safety-Critical Certification
ThreadX has received certification from SGS TÜV Saar for meeting the RTOS-related aspects of standards for safety-critical systems. The certification confirms that ThreadX can be used in the development of safety-related software for the highest safety integrity levels of the International Electrotechnical Commission (IEC) 61508 and IEC 62304, for the “Functional Safety of electrical, electronic, and programmable electronic safety-related systems.” SGS-TÜV Saar has evaluated the relevant parts of Express Logic’s modified waterfall development process for ThreadX v5.6, with phase overlap and phase blending, to ensure that best development practices have been followed in Requirements Management, Design, Implementation, Verification, and Maintenance.

SGS-TÜV Saar, using an extensive test suite, rigorously tested all services and features of the ThreadX RTOS. The ThreadX test suite, comprised of a large number of application simulations, effectively performs functional “black box” testing over the entire ThreadX RTOS. The tests exercise 100 percent of the generic ThreadX C code, which is validated by using code coverage analysis tools. Express Logic’s ThreadX Safety Manual documents these quality assurance measures, which enable developers to use ThreadX in safety-critical software development for even the most rigorous Safety Integrity Level (SIL), according to IEC 61508 or IEC 62304, without further qualification.

Execution Profile Kit
The ThreadX Execution Profile Kit (EPK) provides an infrastructure for applications to dynamically track execution time for threads, Interrupt Service Routines (ISRs), and idle system conditions. This is especially useful for debugging and tuning the application for maximum performance.

Advanced Technology
ThreadX provides thread-management services with advanced technology for low overhead and ease of use.

- Complete Multitasking Facilities
  - Threads, Application Timers, Message Queues, Counting Semaphores, Mutexes, Event Flags, Block and Byte Memory Pools
- Priority-based preemptive scheduling
- Preemption-threshold™ - Unique to ThreadX, helps reduce context switches and help guarantee schedulability.
- Deterministic
- Event Trace - Capture last “n” system/application events
- Event Chaining™ - Register an application-specific “notify” callback function for each ThreadX communication or synchronization object
- Downloadable Application Modules
- Memory Protection
- Run-Time Performance Metrics
  - Number of thread resumptions
  - Number of thread suspensions
  - Number of solicited thread preemptions
  - Number of asynchronous thread interrupt preemptions
  - Number of thread priority inversions
  - Number of thread relinquishes
  - And more ....
- Execution Profile Kit
- Separate Interrupt Stack
- Run-time Stack Analysis
- Optimized Timer Interrupt Processing
- Priority Flexibility - Up to 1024 priority levels

Avidyne’s state-of-the-art DFC100 flight control system uses ThreadX, and is DO-178B certified.

SGS TÜV Saar
FUNKTIONALE SICHERHEIT
GEPRÜFT
FUNCTIONAL SAFETY
APPROVED

Broad Microprocessor Support
ThreadX runs on most popular 32/64-bit microprocessors, out-of-the-box, fully tested and fully supported:

- **Advanced Architectures:** A2P
- **Altera:** NIOS II, Cyclone
- **AMCC:** PowerPC
- **Analog Devices:** SHARC, Blackfin
- **ARC:** ARC 600, 700
- **ARM:** ARM7, ARM9, ARM11, Cortex-M0/M3/M4/R4/R5/A8/A9
- **Atmel:** AVR32, ARM7, ARM9, Cortex-M3
- **CEVA:** CEVA-TeakLite-III
- **EnergyMicro:** EFM32
- **Freescale:** PowerPC, 68K, i.MX, ColdFire, Kinetics
- **Intel:** x86/Pentium, XScale
- **Microchip:** PIC24/PIC32
- **MIPS:** MIPS32, MIPS64, 4k, 24k, 34k, 1004k
- **NXP:** LPC, ARM7, ARM9, Cortex-M3
- **Renesas:** SH, H8, V850, RX, RZ
- **ST:** STM32, ARM7, ARM9, Cortex-M3/M4
- **Tensilica:** Xtensa, Diamond
- **TI:** C5xxx, C6xxx, Stellaris, Sitara, Tiva-C
- **Xilinx:** MicroBlaze, PowerPC405, Zynq

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NetX™ and NetX Duo™

NetX and NetX Duo are Express Logic’s high-performance IPv4 and dual-stack IPv4/IPv6 implementations of TCP/IP protocol standards. Aside from NetX Duo’s IPv6 support, both products are equivalent, and we use “NetX” here to refer to both.

NetX Snapshot

- Small-footprint (small as 5KB, automatic scaling)
- Fast execution (achieve wire speed, no packet copying)
- Supports all popular processors and tools (see below)
- Phase-II IPv6 Ready Logo Certification
- TraceX system analysis support
- BSD-compatible socket layer
- Advanced Features:
  - UDP Fast-Path Technology(TM)
  - Flexible packet management
  - Additional protocols: AutoIP, DHCP, DNS, FTP HTTP, NAT, POP3, PPP, SMTP, SNMP v1-2-3, SNTP, Telnet, TFTP
- Full Source Code
- Royalty-Free

Small Footprint - NetX is implemented as a C library. Only the features used by the application are brought into the final image. The minimal footprint of NetX is as small as 5KB on RISC processors.

Piconet™ Architecture - Many TCP/IP implementations have a considerable number of function calls sprinkled throughout the packet processing path. The elimination of layered function calls and loosely coupled protocol components is what we call a piconet architecture.

Fast Response - With its non-layering Piconet™ architecture and zero-copy API, NetX’s packet processing speed is second to none.

Easy To Use - The NetX API is both intuitive and highly functional. Component names are made of real words and not the “alphabet soup” names that are common to other TCP/IP products.

Flexible Packet Pool Management - The application may create any number of packet pools in any number of memory areas.

UDP Fast Path™ Technology - Basic UDP packets pass through NetX without any copying and without any system context switches.

NetX Protocol Components - NetX provides a complete set of protocol components that comprise the TCP/IP standard, including the following:

- Transmission Control Protocol (TCP)
- Internet Protocol (IP)
- User Datagram Protocol (UDP)
- Address Resolution Protocol (ARP)
- Reverse Address Resolution Protocol (RARP)
- Internet Control Message Protocol (ICMP)
- Internet Group Management Protocol (IGMP)

Zero-Copy API - NetX provides zero-copy TCP/IP communication to eliminate processor cycles consumed by moving data to and from user buffers. Many commercial network stacks process all packets received within a system thread thereby adding a context switch.

NetX Duo Phase-II IPv6 Ready Logo Certification

NetX Duo has achieved IPv6-Ready Logo certification, evidence that it has passed conformance and interoperability tests, administered and validated by the IPv6 Forum. There are two phases of testing, Phase-I and Phase-II. Phase-II is much more rigorous and extensive, and is a superset of Phase-I.

IPsec - NetX Duo (optionally) incorporates IPsec (Internet Protocol Security), a protocol suite for securing Internet Protocol (IP) communications by authenticating and encrypting each IP packet of a communication session. IPsec also includes protocols for establishing mutual authentication between agents at the beginning of the session and negotiation of cryptographic keys to be used during the session. IPsec protects any application traffic across an IP network. Applications do not need to be specifically designed to use IPsec.

Here’s what Sony engineers have said about NetX:

“On this single SPE, we operated the protocol stack NetX, developed for embedded applications, and the microkernel ThreadX required for its operation. Both were manufactured by Express Logic.

As a result, we achieved a TCP performance of 8.5 Gbps for 3-KB packet sizes using a single SPE operating at 3.2 GHz.

This result indicates a competitive network protocol processing performance, considering that we employed a processor designed for a variety of computational applications rather than a dedicated network processor, and demonstrates the potential of the application of SPEs in this field.”


FileX

FileX is Express Logic’s high-performance FAT-compatible file system. It is fully integrated with ThreadX and is available for all supported processors. Like ThreadX, FileX is designed to have a small footprint and high-performance, making it ideal for today’s deeply embedded applications.

FILEX Snapshot

- Small-footprint (small as 6KB, automatic scaling)
- Fast execution (user configurable sector caches)
- Supports all popular processors and tools (see below)
- TraceX system analysis support
- Advanced Features:
  - FAT 12/16/32 support
  - Long filename support
  - performance metrics
- Full Source Code
- Royalty-Free

Small Footprint - FileX is implemented as a C library. Only the features used by the application are brought into the final image. The minimal footprint of FileX is as small as 6KB on CISC processors.

Fast Response - FileX has minimal function call layering, an internal logical sector cache, contiguous cluster allocation, and consecutive cluster reading and writing. All of these attributes make FileX extremely fast!

Easy To Use - FileX is very easy to use. The FileX API is both intuitive and highly functional. In addition, the service names are made of real words and not the “alphabet soup” names that are common to other file system products. Building a FileX application is also easy. Simply include the fx_api.h file in the application software and link the application objects with the FileX library.

Easy to Integrate - FileX is easily integrated with virtually any FLASH or physical media device

No Mysteries - FileX is delivered with complete C source code so you can see exactly how it operates. If you are used to in-house file systems or had bad experiences with “black box” commercial products, this should be most comforting.

Advanced Features

FileX provides many advanced features for embedded file applications, including the following:

- 12-, 16-, and 32-bit FAT support
- Long filename support
- Internal FAT entry cache
- Contiguous file allocation
- Consecutive sector and cluster read/write
- Internal logical sector cache

FileX supports an unlimited number of media devices at the same time, including RAM disks, FLASH managers, and actual physical devices. It also supports 12-, 16-, and 32-bit File Allocation Table (FAT) formats, contiguous file allocation, and it is highly optimized for both size and performance. Designed to meet the growing need for FLASH devices, FileX uses the same design and coding methods as ThreadX. Like all Express Logic products, FileX is distributed with full ANSI C source code, and it has no run-time royalties.

Product Highlights

- No royalties
- Complete ANSI C source code
- Real-time performance
- Responsive technical support
- Unlimited FileX objects (media, directories, and files)
- Dynamic FileX object creation/deletion
- Flexible memory usage
- Size scales automatically
- Small footprint (as low as 6 KBytes) instruction area size: 6-30K
- Complete integration with ThreadX
- Endian neutral
- Easy-to-implement FileX I/O drivers
- RAM disk demonstration runs out-of-the-box
- Media format capability
- Error detection and recovery
- Fault tolerant options
- Built-in performance statistics
USBX is Express Logic’s high-performance embedded USB host/device/OTG stack. It is fully integrated with ThreadX and is available for all ThreadX supported processors. Like ThreadX, USBX is designed to have a small footprint and high-performance, making it ideal for today’s deeply embedded applications that interface with USB devices or are connected with a Windows/Apple/Linux desktop over USB.

**USBX Snapshot**

- Small-footprint (small as 10KB, automatic scaling)
- Fast execution
- Supports all popular processors and tools (see below)
- Passed USB-IF USBCV Test
- Passed OTG Protocol Test (OPT)
- TraceX system analysis support
- Host, Device, and OTG support
- Extensive Device Class support: CDC, HID, PIMA, RNDIS, STORAGE
- Extensive Host Class support: ASIX, AUDIO, CDC, HID, HUB, PIMA, PRINTER, PROLIFIC, STORAGE
- Full Source Code
- Royalty-Free

**Small Footprint** - USBX is implemented as a C library. Only the features used by the application are brought into the final image. The minimal footprint of USBX is under 10KB.

**Easy To Use** - USBX is very easy to use. The USB API is both intuitive and highly functional. In addition, the service names are made of real words and not the “alphabet soup” names that are common to other USB products. Building a USBX application is also easy. Simply include the ux_api.h file in the application software and link the application objects with the USBX library.

**Powerful Services of USBX**

**Multiple Host Controller Support**

USBX can support multiple USB host controllers running concurrently. This feature allows USBX to support the USB 2.0 standard using the backward compatibility scheme associated with most USB 2.0 host controllers on the market today.

**USB Software Scheduler**

USBX contains a USB software scheduler necessary to support USB controllers that do not have hardware list processing. The USBX software scheduler will organize USB transfers with the correct frequency of service and priority, and instruct the USB controller to execute each transfer.

**Complete USB Device Framework Support**

USBX can support the most demanding USB devices, with multiple configurations, multiple interfaces, and multiple alternate settings.

**Major Features**

- Host/Device/Combined Operation
- USB low speed, full speed and high speed are supported
- Supports all embedded CPUs
- Supports many USB host/device controllers in discrete or IP form integrated with a SOC including Synopsis, Philips, Atmel, PowerPC, ColdFire, STM32, NXP, Renesas SH-2A and V8xx, Microchip PIC32, and ADI Blackfin.
- Supports many standard USB class drivers including Mass Storage, Printer, HID, Asix, Audio, Hub, RNDIS, CDC, Pima 15740 and Pictbridge
- Integrated with Express Logic components (FileX and NetX)

USBX supports the two existing USB specifications: 1.1 and 2.0. It is designed to be scalable and will accommodate simple USB topologies with only one connected device as well as complex topologies with multiple devices and cascading hubs. USBX supports all the data transfer types of the USB protocols: control, bulk, interrupt, and isochronous. USBX supports both the host side and the device side. Each side is comprised of three layers:

- Controller layer
- Stack layer
- Class layer

**USBX Host mode** - USBX in host mode is used when the application requires communication with USB devices such as a USB keyboard, a USB printer or USB Flash disk.

**USBX Device mode** - USBX in device mode is used when the application requires communication with a Windows/Apple/Linux desktop. In this case the embedded device is considered to be a USB device or slave.
GUIX

GUIX is Express Logic’s high-performance graphical user interface framework. GUIX includes a full-featured runtime UI library and a matching desktop design application named GUIX Studio. GUIX is fully integrated with ThreadX and is available for many processors supported by ThreadX. Designed to meet the growing need for dynamic user interfaces with limited hardware resources, GUIX uses the same design and coding methods as ThreadX. And like all Express Logic products, GUIX is distributed with full ANSI C source code, and has no run-time royalties.

GUIX Snapshot

- Small-footprint (small as 6 KB, automatic scaling)
- Complete windowing support, including multiple screens with varying sizes and color formats, multiple canvases, window blending and fading, sprites, and dynamic animations.
- Fast execution (optimized clipping, drawing, and event handling)
- Comprehensive set of built-in widgets and controls
- Supports monochrome through 32-bit true-color with alpha graphics formats.
- Support for hardware assisted graphics acceleration and multiple hardware graphics planes.
- GUIX Studio – Desktop user interface design tool
- Full Source Code
- Royalty-Free

Small Footprint

GUIX is implemented as a C library. Only the features used by the application are brought into the final image. The minimal footprint of GUIX is as small as 6KB on most processors.

Fast Execution

GUIX has minimal function call layering, and optimized clipping, drawing, and event handling. All of these attributes make GUIX extremely fast!

Easy To Use

GUIX is very easy to use. The GUIX API is both intuitive and highly functional. In addition, the GUIX Studio application makes GUI design programming-free, with WYSIWYG operation and automatic code generation.

Easy to Integrate

GUIX is easily integrated with virtually any display technology. In addition, Express Logic offers engineering services to create custom display drivers for GUIX.

No Mysteries

GUIX is delivered with complete C source code so you can see exactly how it operates. If you are used to in-house user interface products or have had bad experiences with “black box” commercial products, this should be most comforting.

Create Elegant User Interfaces

GUIX provides all the features necessary to create the most elegant user interfaces. The standard GUIX package includes various sample user interfaces, including the medical device demonstration shown here.

GUIX Studio

GUIX Studio enables developers to prototype their designs on a PC, without any programming at all. GUIX Studio provides a complete WYSIWYG screen design environment which allows the user to drag-and-drop graphical elements used to build the UI screens. GUIX Studio automatically generates C code compatible with the GUIX library, ready to be compiled and run on the target.
GUIX Studio is a Microsoft Windows-based, WYSIWYG rapid UI development tool specifically designed by Express Logic to accompany its GUITEMP target GUI development framework. Embedded UI Developers can utilize GUIX Studio to quickly create and update embedded UI designs for MCU and MPU-based target systems. GUIX and GUIX Studio combine to make the development of modern embedded graphical user interfaces easy.

GUIX Studio Highlights
- Windows-based prototyping and development of embedded GUIs
- WYSIWYG intuitive design functionality
- Automatic code generation ready for use in target project, or as stand-alone Windows executable
- Object creation, editing, cut, copy, and paste operations
- Fully supports multi-lingual applications
- Flexible color palette selection and extension
- Management of all UI resources the application will use for colors, fonts, pixelmaps and strings
- Support for up to 4 displays per project. Multiple displays can be of different resolution, color depth, and orientation
- Support for designs with up to 100,000 widgets. This enables the creation of GUIs that range from very simple to extremely complex, to meet a variety of application needs
- Supports up to 100,000 distinct resources, e.g., colors, fonts, pixelmaps, strings, etc., giving the designer a vast set of tools with which to craft the most effective and user-friendly interface possible

Target View
The Target View is the WYSIWYG screen design and layout area for a GUIX Studio embedded user interface. It is the “canvas” on which the GUI is designed. Objects can be selected, moved, resized, etc., via simple, intuitive mouse operations. In addition, alignment and Z-order button operations are available in the Target View.

Properties
Selecting an object in the Target View will result in the properties for that object being displayed in the Properties View panel. The Properties View shows detailed information for the selected object.

Widgets
Widgets are the building blocks of the UI, and include objects such as windows, buttons, and prompts. Widgets can be added to a blank canvas, or as children of other widgets. The “Insert” menu enables selection and creation of various widget types, including:

- Windows
- Text Strings
- Containers
- Indicators

Colors
Color resources consist of one or more colors, each with a unique logical name. For example, in the figure below, the logical name CANVAS is associated with the physical color black. This color resource is used whenever the application specifies CANVAS as the color in the object properties.

Modifying a color resource is easy, simply double-click (or right-click and menu select) on the color resource. From this dialog the color resource can be modified to match the application’s UI needs.

Fonts
GUIX Studio can utilize any TrueType font the user system offers. Fonts can be added at any time, and easily modified, simply by double-clicking (or right-click and menu select) on the font resource. From this dialog the font resource can be modified to match the application’s UI needs.

Text Strings
Text strings can be created and modified to match the application’s UI needs. The GUIX Studio String Table Editor gives developers a convenient method to define strings in any number of languages. The developer can add notes to each string to assist language translators in providing meaningful translations. String data can be exported or imported using industry standard XLIFF language data exchange format.

Multiple Language Support
Each string can be configured with multiple language versions, enabling easy language selection for the entire GUI. The GUITEMP string and language management component supports up 280 distinct simultaneous languages. The developer can create the UI application using his or her familiar language during and after completion.

GUIX Studio Generated Code
GUIX Studio produces ANSI C source files for use in an embedded project. These files contain the application resources and data structures for your designed screens. GUIX Studio also generates the functions that utilize the generated data structures to dynamically create your application GUI. The user’s embedded application code makes references to the code generated by GUIX Studio. The GUIX Studio generated code enables custom widget drawing, event handling, and memory allocation functions to be defined in the user’s embedded application code.
TraceX®

TraceX is Express Logic’s host-based analysis tool that provides developers with a graphical view of real-time system events and enables them to visualize and better understand the behavior of their real-time systems.

TraceX Snapshot

- Visual system analysis tool for applications using ThreadX, NetX, FileX, and USBX
- Extensive event search and navigation facilities
- Easily measure delta time between events
- Zoom in-out
- Sequential and Time display modes
- Automatically detect priority inversions
- Easily add custom user events
- Built-in performance analysis
- Execution profile, including Idle and ISR time
- Thread stack usage profile
- Performance statistics (context-switches, etc)
- FileX statistics (file read/writes, etc.)
- NetX statistics (packets sent/received, etc.)
- Multicore Support
- Runs on any Windows host
- No license keys

Target-Resident Buffer Holds Event Log Information

Trace information is stored in a circular buffer on the target system, with the buffer location and size determined by the application at run-time. The trace information may be uploaded to the host for analysis at any time – either post mortem or upon a breakpoint.

Sequential Mode

TraceX can operate in Sequential Mode or Time Mode. In Sequential Mode, all events are displayed back-to-back, regardless of the time between them. This enables developers to see all system events, in correct sequence, compressing time into the smallest possible area.

Time Mode

In Time Mode, events are separated along the horizontal axis, according to their real-time occurrence. A time scale appears at the top to indicate the number of clock ticks between events, and the clock tick duration of each thread’s run-time.

TraceX is Like a Software Logic Analyzer

Once the event log has been uploaded from target memory to the host, TraceX displays the events graphically on a horizontal axis representing time, with the various application threads and system routines to which the events are related listed along the vertical axis. TraceX creates a “software logic analyzer” on the host, making system events plainly visible. Events are represented by color-coded icons, located at the point of occurrence along the horizontal timeline, to the right of the relevant thread or system routine. When an event icon is selected, the corresponding information for that event is displayed. This provides quick, single-click access to the most immediate information about the event and its immediately surrounding events. TraceX provides a “Summary” display that shows all system events on a single horizontal line to simplify analysis of systems with many threads.

Trace Data Collected By ThreadX® RTOS

TraceX is designed to work with Express Logic’s ThreadX RTOS, which constructs a database of system and application “events” on the target system during run-time. These events include:

- Thread context switches
- Preemptions
- Suspensions
- Terminations
- System interrupts
- Application-specific events
- All ThreadX API calls

Events are logged under program control, with time-stamping and active thread identification so they can be displayed later in the proper time sequence, and associated with the appropriate thread. Event logging may be stopped and restarted by the application program dynamically, for example, when an area of interest is encountered.