LYNX | OS-178®

Certifiable RTOS for safety-critical computing & Lynx Mosaic compatible module

LynxOS-178 RTCA/DO-178B/C, level A Certified RTOS and FAA-accepted Reusable Software Component

LynxOS®-178 RTOS is the first DO-178B/C and EUROCAE/ED-12B level A certified operating system to offer both the interoperability benefits of POSIX® and support for the ARINC 653-1 Application EXecutive (APEX) interface. The resulting COTS solution provides open and industry recognized interfaces between the system hardware and applications that enable the most capable systems for Integrated Modular Avionics platforms.

LynxOS-178 claims the first and only time and space partitioned, FAA-accepted Reusable Software Component (RSC) award as defined by advisory circular 20-148, with support for Intel® PowerPC® and ARM.

LynxOS-178 is built on open standards and designed specifically to fulfill the stringent needs of multi-process and multi-threaded applications used in safety critical systems.

ARINC 653-1 Conformance

ARINC 653-1 brick-wall partitions make it impossible for system events in one partition to interfere with events in another. Each partition can be equated to existing as its own separate virtual computer having non-shared and fixed hardware resources.

Memory and resources are not shared between the partitions in a LynxOS-178 system. Each partition has access to statically pre-allocated memory and operating system resources. Partition memory is protected by the hardware MMU eliminating any chance of a process execution in one partition to inadvertently access memory owned by a different partition.

An optimized ARINC 653-1 based scheduling algorithm ensures that the system is deterministically safe while providing each partition with fixed cycles of execution time. The partition execution time windows are guaranteed regardless of operations occurring in the other partitions.

Features & Advantages

- **Low risk — DO-178B/C level A reusable certification**

- **Reduced cost — Elimination of man-years of certification effort**

- **Reusable Software Component (RSC) — First and only time and space partitioned, FAA-accepted RSC**

- **Open Standards Conformance — Ensures application portability, software reuse and interoperability**

  - **POSIX — POSIX.1 with POSIX 1.b, real-time extensions, and POSIX 1.c , threads extensions**
  - **ARINC 653-1— Application EXecutive (APEX)**

- **Certifiable Networking — Lynx Certifiable Stack comprehensive support for networking protocols**

LynxOS-178 provides APIs for the Future Airborne Capability Environment (FACE):

- **FACE Security Profile APIs**
- **FACE Safety Profile APIs**
- **FACE Security Extended Profile APIs**
- **additional ongoing coverage**

The FACE standard is designed to enhance the U.S. military aviation community's ability to address issues of limited software reuse and accelerate and enhance warfighter capabilities.

Lynx Software Technologies™ is an Associate Sponsor of FACE, an industry consortium. The FACE technical standard defines a reference architecture for creating a common operating environment to support applications across multiple Department of Defense avionics systems.

The ARINC 653-1 Health Monitor is an integral component of the LynxOS-178 operating system. The Health Monitor oversees and reports the health of the hardware and software. Health Monitor functions are performed at two levels: partition and system. Health Monitor logging can include system hardware error data for devices connected via the peripheral component interconnect (PCI) bus. In addition the number of power-on cycles, total operational time, and time since last service date data is maintained.

LynxOS-178 provides the following ARINC 653-1 mandated system service groups:

- Partition management
- Process management
- Time management
- Inter-partition communications (sampling ports and queuing ports)
- Intra-partition communications (buffers, blackboards, semaphores and events)
- Health monitoring

Diagram:

APPLICATION SOFTWARE

Partition 0 Level A/B: Cinit, HEALTH MONITOR, POSIX

Partition 1 Level B: ARINC, POSIX, SOCKETS

Partition 2 Level D: ARINC, POSIX, SOCKETS

Partition 3 Level C: ARINC, POSIX, SOCKETS

Partition N Level E: SNTP, POSIX, SNMP v3, SOCKETS

User mode / Supervisor mode

SYSTEM SOFTWARE

VCT | LYNX OS-178 PARTITIONING KERNEL | ARP/ICMP/IGMP | FTP/TFTP | TCP/IP/UDP

HARDWARE

CSP (CPU SUPPORT PACKAGE) | BOARD SUPPORT PACKAGE | STATIC DEVICE DRIVERS | PCI DRM | DYNAMIC DEVICE DRIVERS

MICRO PROCESSOR | HARDWARE | PCI CONTROLLER | PCI A PCI B | OPTIONAL HARDWARE

Inter-Partition Communication

LynxOS-178 offers developers the flexibility of advanced networking features including the Lynx Certifiable Stack which provides users with TCP/IP, UDP, ARP, ICMP, IGMP, FTP and TFTP protocols on a per partition basis certifiable up to DO-178B/C level A. Users can configure network applications with SNMPv3 and SNTP for added flexibility.

Applications can also make use of the ARINC 653 ports interface to communicate across partition boundaries. ARINC 653 ports can be configured on multiple hardware modules for seamless communication between applications.

Full DO-178B/C Level A Acceptance

LynxOS-178 is a FAA-recognized Reusable Software Component (RSC) that meets all objectives of RTCA/DO-178B/C. This function allows LynxOS-178 to be used in multiple projects without having to regenerate certification artifacts.

The LynxOS-178 RSC is more than just a set of DO-178B/C artifacts. The documentation set includes a detailed partitioning and interface analysis that focuses on time, space and resource partitioning as well as timing margin analysis so developers can allocate budgets to use LynxOS-178 system services.
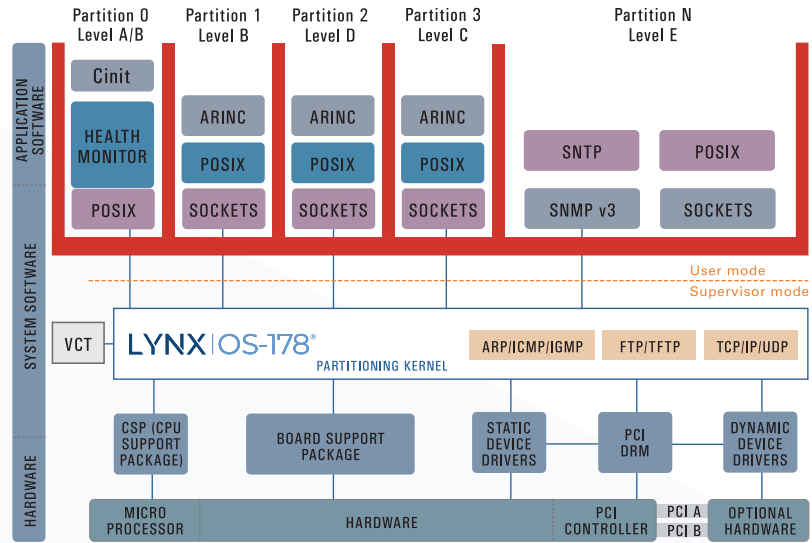
The set of RSC guidance documentation includes requirements, design data, test suites and coverage analysis to meet DO-178B/C requirements.

Additionally, LynxOS-178 comes with an Eclipse-based development environment which includes tools necessary for debugging and fine-tuning the performance of safety-critical systems. The complete package includes full customer support and DO-178B/C consulting services from the specialists at Lynx Software Technologies.

Full POSIX Conformance

The POSIX standard was developed by the Institute of Electrical and Electronics Engineers (IEEE) and is maintained by The Open Group. POSIX is recognized by the International Organization for Standardization (ISO) and American National Standards Institute (ANSI).

POSIX conformance assures code portability between systems and is mandated for increasing commercial applications and government contracts. POSIX contains the native LynxOS-178 interface, and POSIX calls are included as part of the add-on library for the operating system ensuring maximum performance.

LynxOS-178–The Safest Solution

Certification of software to DO-178B/C and EUROCAE/ED-12B has traditionally demanded multiple years of effort resulting in considerable costs and time-to-market penalties.

LynxOS-178 now allows companies to mitigate both schedule and cost risk. LynxOS-178 provides a well-known certifiable package at a predictable cost potentially saving thousands of man-hours, over the course of a certification project.

Developers can bring their safety-critical products to market faster than ever by leveraging software and artifacts that have been previously certified. Once again, Lynx Software Technologies leads the industry as LynxOS-178 ushers in a new era of productivity for safety-critical system development.

LynxOS-178 runs as a standalone product and also as a LYNX MOSA.ic framework compatible module. The modular nature of designs built with the LYNX MOSA.ic framework allows these systems to be realized in a Robust, Rapid, and Reusable fashion across multiple product generations.