



Real-time Linux and BSD Status Report and Reality Check

FSMLabs customers have been building products based on FSMLabs fully deterministic low microsecond interrupt latency real-time Linux and BSD solutions into products for a decade. While others have announced real-time Linux was either impossible or going to be available soon, RTLinux and RTCore BSD have been powering mission critical working systems ranging from robots, to simulators, wireless routers, machine tools, network routers and VOIP gateways and many other successful products. FSMLabs has been innovating, increasing ease of use on the pure POSIX 1003.13 API, creating an industry leading quality assurance infrastructure, and building up a world wide customer support organization. Recent advances include ARINC 653 scheduling, flexible support for multi-core processors, and Matlab/Simulink compatibility. Do178b certification and hardware virtualization are in progress. With 2 microseconds worst case interrupt latency on an AMD

RTCore Technology benefits

Easy to learn real-time uses POSIX standard threads API conforming to POSIX 1003.13 PS51+.

Performance and reliability via a low microsecond worst-case latency that is, by design, protected against interference from non-real-time code.

Reuse existing code and applications that run on Linux or BSD. Both systems can be employed as a “client” for running non-real-time software - including drivers. Real-time code can be moved between BSD and Linux as convenient.

Solid, reliable system that is tested on many architectures and that offers options like the ability to run untrusted code in user space closed partitions (PSDD).

Take full advantage of choices in processors with support for many chip architectures and full support of SMP including thread processor assignment, on-demand processor reservation, decoupled multi-processor schedulers, interrupt focus, and multi-core capability

Real-time connectivity VME, USB, Firewire, StdBus 1553, and CanBus.

Zero copy real-time networking including 1G Ethernet.

A “no kernel programming” standard C environment for components including code generated automatically from MatLab and Rhapsody. Eclipse based IDE.

An ARINC 653 time and space partitioned scheduler. Processor independence and flexibility with support for everything from multi-core x86-64 to Arm. MIPS

Opteron and 20 on an ARM9, the technology has been proven to be scalable and durable.

Here is what some of FSMLabs customers say.



**Joel Darnold
Senior MTS
Sandia National
Labs**

We began incorporating RTLinux into our systems about four years ago and have

experienced outstanding performance and reliability. Two of our mission critical systems have now been successfully deployed and much of our success can be directly attributed to FSMLabs' product and outstanding support.



Jason Redi, Director, R&D of Mobile Networking , BBN
At BBN we have been using FSMLabs' RTLinuxPro for many years for our wireless MAC protocol efforts. RTLinux provides the rock-solid thread switching times and perfect reliability that we need to build high performance software for next generation wireless networking. When combined with the familiar Linux environment and tools, we have a hard-real time kernel that is exactly right for building high speed wireless protocols"



Tim Kaiser, WIN-T Software IPT Lead, Harris
At Harris we have used FSMLabs' RTLinux on two product versions of our Highband Network Waveform and Mobile Ad Hoc radio. The first version ran in a single board Pentium configuration. The follow on product runs off Dual Power PC and Quad power PC configurations. The waveform is Ad Hoc, self forming and uses Time Division Multiple Access timing to produce a 20+ Mbit/sec user throughput. This radio technology has been through a highly successful Demonstration Test - Operational Test evaluation at customer test sites. It has been enthusiastically perceived as the answer to tactical radio communications. The real time kernel provided by the RTLinux product provided deterministic timing down to microsecond granularity that is critical to the success of the waveform. The threading process allowed us to use the multiple processors concurrently to meet system performance. FSMLabs' product has been a solid platform to develop and field within our product radio. Their support of the operating system has been top notch.



Robert Krohn, Senior Director, Platform Engineering, Juniper Networks"
FSMLabs RTCore technology gave us a low risk modular path to add hard real-time processing. PSDD provided high speed real-time within the protected memory of UNIX process. FSMLabs support is technically solid and very responsive.



Dean Anneser, Software Engineering Fellow, Pratt & Whitney
RTLinux provides a very cost effective scalable multiplatform solution (x86/ppc) for our simulation, control, and data acquisition systems. This toolset is used extensively with software developed by Pratt & Whitney and Hamilton Sundstrand for the development and testing of electronic engine controls and control of engine test facilities. PSDD with RTLinux provides the two capabilities essential for our application - user-mode frame based scheduling across

multiple cpus, and the ability of one process to easily read/write user variables in another process.



Richard Bond, principal real-time specialist (ret.), Lockheed Martin
RTLinuxPro and PSDD enabled simple simulation framework allowed me the choice to develop user-level I/O drivers, and provided outstanding performance.

Stuart Adams CEO



Bright Star Engineering.

Bright Star has delivered over 10,000 automotive diagnostic systems running RTLinuxPro to DaimlerChrysler over the last three years. RTLinuxPro provided the precise real-time needed to collect data and to manage a family of complex protocols. RTLinuxPro also allowed us to seamlessly add new processor architectures: the original systems were MIPS based and we are now also delivering systems on our MPC5200 powerEngine platform.



RTLinuxPro Case Study - from Syrinix Ltd.

Syrinx's technology enables the early detection of leaks on trunk main water distribution networks, allowing a repair to be made before the pipe fails catastrophically. RTLinuxPro is a core component of its TrunkMinder system facilitating the precision flow of data from its automated remote sensor network. This is crucial for producing accurate models of pipe-network behavior, exact pin-pointing of leak locations and tracking transient events as they pass through the pipe-network. Running on an Intel PXA powered board produced by Arcom and enhanced by some custom hardware, the software on the sensor station:

- ❖ *Controls the data flow from the multi-channel sensor pack attached to the pipe.*
- ❖ *Synchronises the timing of the data using the Navstar GPS.*
- ❖ *Performs low level signal processing on the sensor data.*
- ❖ *Packages the data and transmits it to a central processing node using IBM's websphere protocol MQTT.*

All of these tasks are performed continuously and in real-time. Scheduling problems and unacceptable context switching delays experienced with other embedded Linux operating systems were resolved when basing the system on RTLinuxPro.