



Real Time Linux

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□ Objective

–Show that Linux can work as a real time operating system with public domain Linux and open source patches

□ Method

–Measure the interrupt latency time of the kernel under various load conditions with and without preemptive scheduler patch

The Operating System

- ❑ **Linux was originally written as a multiprocessing general purpose operating system, real time was not a consideration.**
- ❑ **Real time applications have become a consideration for Linux. Patches have been written to make Linux real time which are being adopted into the main tree.**
- ❑ **Preemptive scheduler patch created by MontaVista and maintained by Robert Love.**
- ❑ **This work uses Linux 2.4.19 from the Galileo tree. One set of results are done without the preemptive scheduler patch and one set is done with the preemptive scheduler patch.**

Interrupt Latency

While a process is waiting for an interrupt, the interrupt latency is the time a processor takes to respond to that interrupt.

Interrupt latency will depend on other operations the processor is doing at the time of the interrupt therefore interrupt latency varies from moment to moment.

For a real time application, the user needs to know the maximum time needed for system to respond. In order to respond to the worst case, maximum interrupt latency is the most important parameter.

The Realfeel Benchmark

- ❑ **Written by Mark Hahn.**
- ❑ **Can be downloaded from**
www.van-dijk.net/linuxkernel/200204/0732.html
- ❑ **The benchmark measures interrupt latency. It must be run under various load conditions. For this work, we chose three scripts**
 - Find script - Copies various kernel structures to nowhere
 - Launch script - Continuously launches trivial programs
 - File move script - Continuously moves files
- ❑ **The benchmark was run on a Power PC operating at 312.5 Mhz. The system controller chip was a Marvell Discovery operating at 125 MHz. The system was connected to the network and had no disk drive.**

Largest Interrupt Latency Time Measured

Results are measured from 3.5 million samples

Script

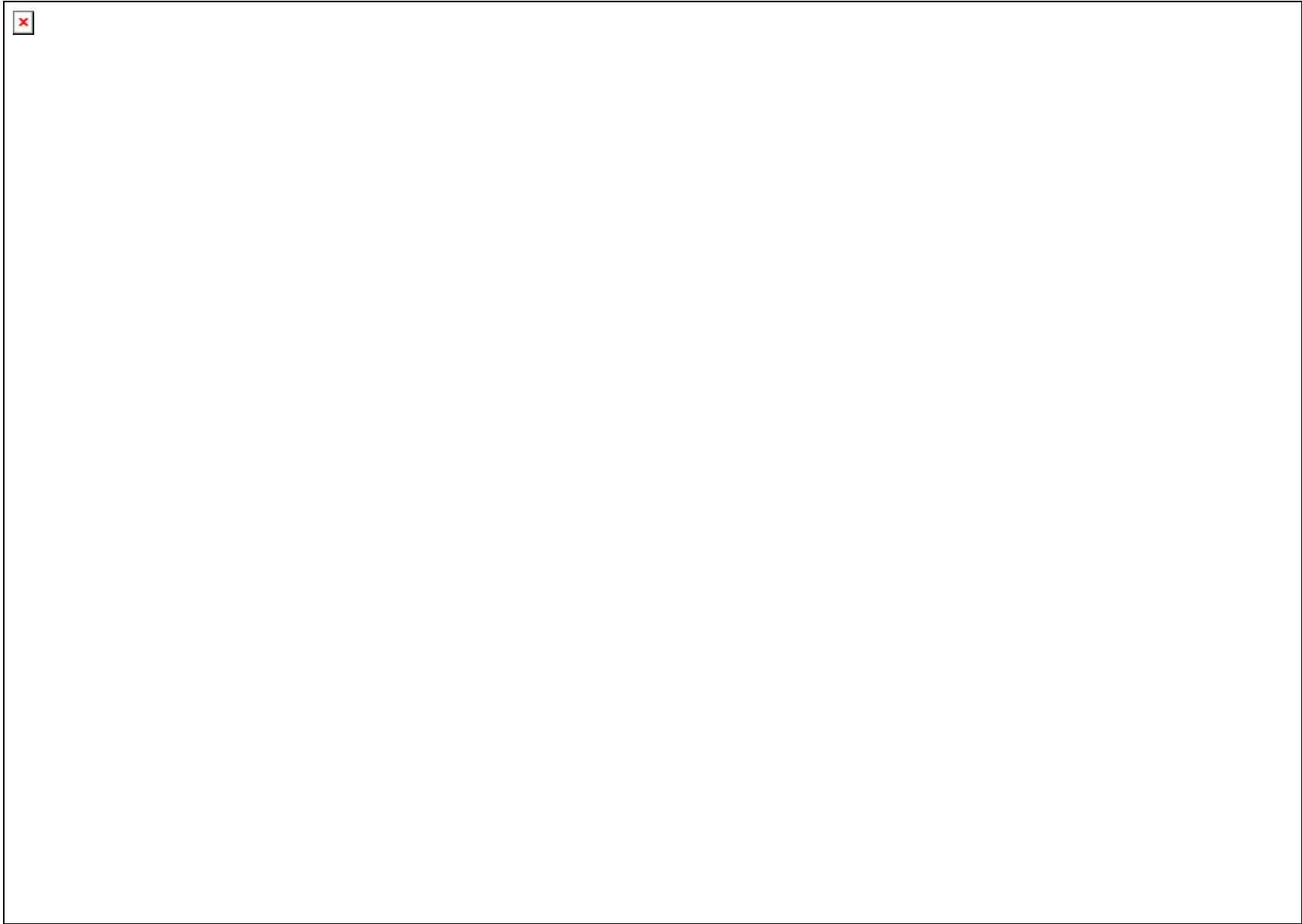
Interrupt latency

without preemptive
kernel patch

with preemptive
kernel patch

Find Script	78.51 ms	0.48 ms
Launch Script	0.61 ms	0.41 ms
File move script	0.62 ms	0.31 ms

Results



Conclusions

- ❑ **While standard Linux is at best soft real time, Linux modified with preemptive scheduler patch can deliver sub microsecond interrupt latency.**

- ❑ **Real time patches are becoming part of standard Linux and are public domain.**

- ❑ **Real time Linux allows real time applications to be developed for machines which are open source. This allows customers to control their environment and allows vendor independence.**