Stephen Tarzia

t-kernel: Provide Reliable OS Support for Wireless Sensor Networks
Lin Gu and John A. Stankovic

t-kernel is an OS that uses load-time binary translation to implement important OS features on simple microprocessor architectures that lack certain enabling features.

Specifically, they implement kernel/user space separation, virtual memory, and task preemption. There is some overhead from the load-time binary translation (they call this process naturalization). Essentially, they invoke a version of Amdahl's law to argue that slowdowns of up to 4 times and increased power consumption are irrelevant when the affected portion is less than 1% (sensor nodes spend most of their time sleeping). They make a good case for the usefulness of these OS features to sensor nodes. This work is also a step in the direction of better design abstraction and code portability in embedded systems: code can be written with virtual memory and task concurrency and then run both on systems with and without hardware support for VM, kernel mode, etc.

When confronted with the question: why not use a more advanced microprocessor?, they answer that it's more expensive and because the sensor node manufacturers aren't upgrading. It seems unlikely that cost will remain an issue in the future and the sensor node manufacturers will always yield to the market's demands. Also, I am a little skeptical that idle-leakage is the main contributor to battery life in these systems. Also, their preemptive scheduler seems weak (the highest priority task is never preempted, so starvation can occur).

I think that this paper is important as an attack on the last stronghold of ad hoc software and hardware design: embedded systems. The authors show the benefits of heirarchy/abstraction even very simple systems. The authors point out the development of an optimizing compiler as a logical continuation of this work.

Steve Tarzia