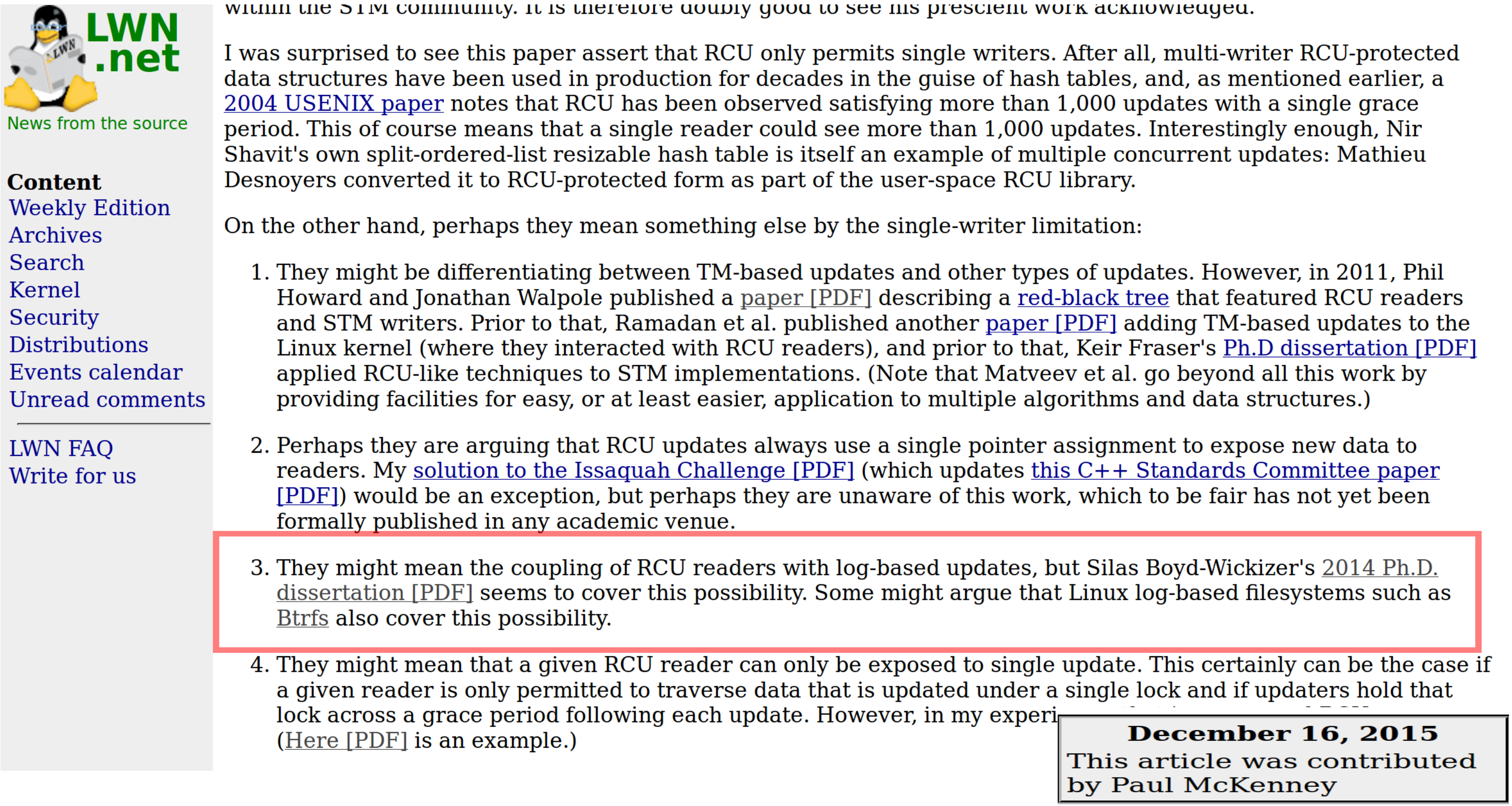

within the STM community. It is therefore doubly good to see his prescient work acknowledged.

I was surprised to see this paper assert that RCU only permits single writers. After all, multi-writer RCU-protected data structures have been used in production for decades in the guise of hash tables, and, as mentioned earlier, a 2004 USENIX paper notes that RCU has been observed satisfying more than 1,000 updates with a single grace period. This of course means that a single reader could see more than 1,000 updates. Interestingly enough, Nir Shavit's own split-ordered-list resizable hash table is itself an example of multiple concurrent updates: Mathieu Desnoyers converted it to RCU-protected form as part of the user-space RCU library.

On the other hand, perhaps they mean something else by the single-writer limitation:

1. They might be differentiating between TM-based updates and other types of updates. However, in 2011, Phil Howard and Jonathan Walpole published a paper [PDF] describing a red-black tree that featured RCU readers and STM writers. Prior to that, Ramadan et al. published another paper [PDF] adding TM-based updates to the Linux kernel (where they interacted with RCU readers), and prior to that, Keir Fraser's Ph.D dissertation [PDF] applied RCU-like techniques to STM implementations. (Note that Matveev et al. go beyond all this work by providing facilities for easy, or at least easier, application to multiple algorithms and data structures.)

2. Perhaps they are arguing that RCU updates always use a single pointer assignment to expose new data to readers. My solution to the Issaquah Challenge [PDF] (which updates this C++ Standards Committee paper [PDF]) would be an exception, but perhaps they are unaware of this work, which to be fair has not yet been formally published in any academic venue.

3. They might mean the coupling of RCU readers with log-based updates, but Silas Boyd-Wickizer's 2014 Ph.D. dissertation [PDF] seems to cover this possibility. Some might argue that Linux log-based filesystems such as Btrfs also cover this possibility.

4. They might mean that a given RCU reader can only be exposed to single update. This certainly can be the case if a given reader is only permitted to traverse data that is updated under a single lock and if updaters hold that lock across a grace period following each update. However, in my experi
(Here [PDF] is an example.)

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This article was contributed by Paul McKenney