A more efficient way to write data into non-volatile memory devices improves their performance

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A scheme to write data into next generation memory chips has been developed by A*STAR Data Storage Institute researchers. The proposal by Jun Yang and colleagues requires considerably less resources to write data safely into memory—even during a system failure.

Non-volatile memory (NVM) technologies are the likely successor to current computer memory devices. A key advantage is their ability to keep data in the memory even when the computer is powered off, enabling virtually instant computer boots. NVM could even replace the computer hard drive, and thus unify the different memory types used by a computer in a single device.

One challenge when using NVM in computers is ensuring the accuracy of the data to be stored. NVM devices utilize different materials than existing silicon memory technology and so have different write processes and storage needs.

"Directly applying these existing approaches on byte-addressable NVM is inefficient," says Yang. Therefore, they require algorithms that are optimized for the unique properties of the new memory types but also remain compatible with the requirements of current computer processors.

Another concern is memory operations. If memory operations occur

during a system failure, such as a computer system crash, there is a chance that the memory could become corrupt with wrong data.

The process used to store data—the sequence in which pieces of data are written into the memory—is key to the efficient storage of information. The data structure in the memory should be such that changes in one part of the data do not require extensive reorganization of the entire memory.

In their work, Tang's team adapted a version of the commonly used B+ tree architecture for organizing memory data. Then, following a systematic investigation into the performance of that data structure for NVM systems, the team adapted it for use in NVM.

The data are separated into two groups, critical data and reconstructable data. Reconstructable data, in principle, can be derived from the critical data. Therefore, the priority during the writing process is to ensure the consistency of the critical data, which are written into the memory first.

The new NV tree data structure can be up to 96 per cent more efficient in the operation of NVM, moving this technology closer to applications says Yang. "The new data structure makes it possible to build a more sophisticated storage system specifically optimized for NVM."

More information: Jun Yang et al. NV-Tree: A Consistent and Workload-Adaptive Tree Structure for Non-Volatile Memory, *IEEE Transactions on Computers* (2016). DOI: 10.1109/TC.2015.2479621

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