RAID With SD Cards

The “block” in block device means you’ll be blocked from doing it…

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Why would you make RAID with SD Cards?

We wanted a project that focuses more on the software side than the hardware and verilog side, so our goal was to implement RAID through a Linux Kernel Module.

RAID through SD cards is useful in embedded applications where large amounts of data is collected and redundancy is necessary.

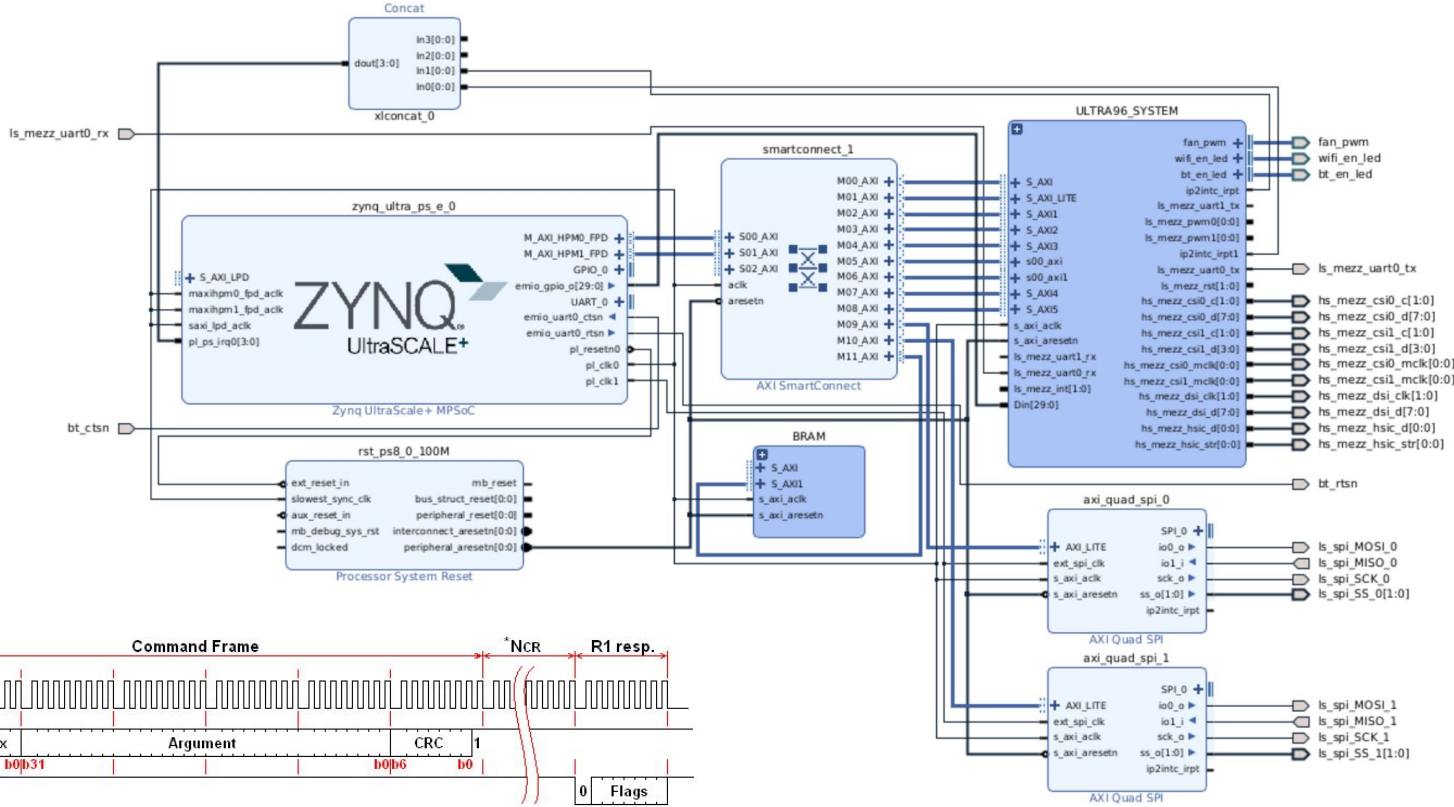
Linux storage devices require block device drivers

Similar to char devices, but has a request function instead of read and write.

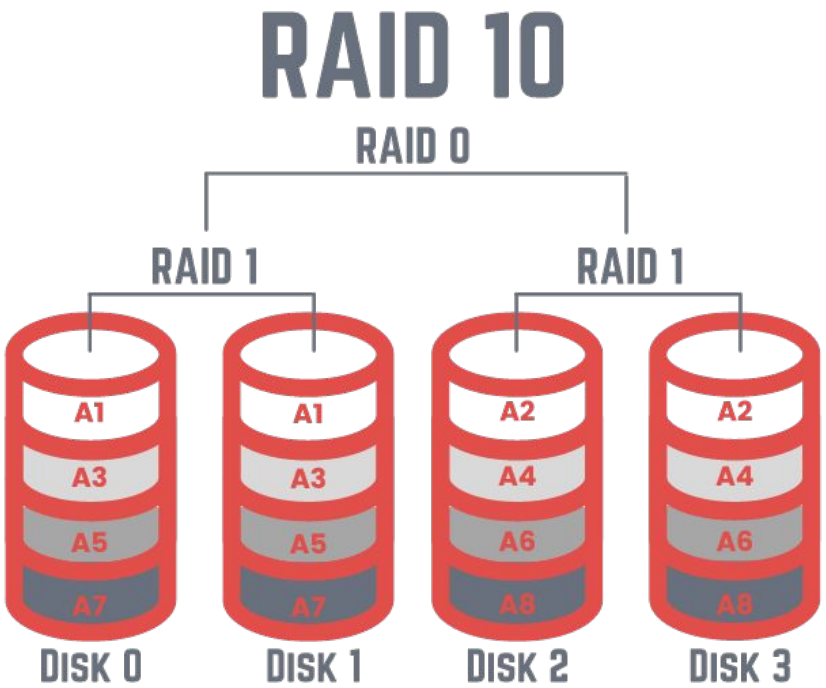
Driver iterates over a linked list of blocks in memory and submits them to the device.

More advanced drivers can re-order requests in the queue to optimize operations on storage devices with moving parts.

SD Card Interface and Drivers



Using RAID 10 for striping and mirroring



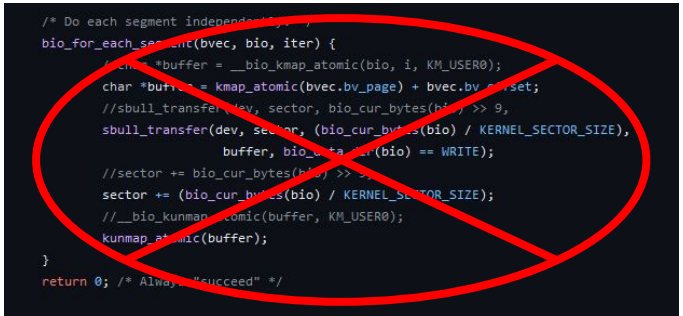
https://www.salvagedata.com/what-is-raid-10-and-its-advantages/

Block device drivers don’t work on the Ultra96v2

We could not get a block device driver to work on the Xilinx Linux Kernel.

We were able to run sbull, an example block device driver, on a 5.10 linux server.

We think there’s a bug causing some kind of fault when iterating over segments of a request on Xilinx versions of the kernel. We tested images with Petalinux 2020.2, 2021.2, and 2022.2, each having similar crashes.



We pivoted towards making a program that journals data

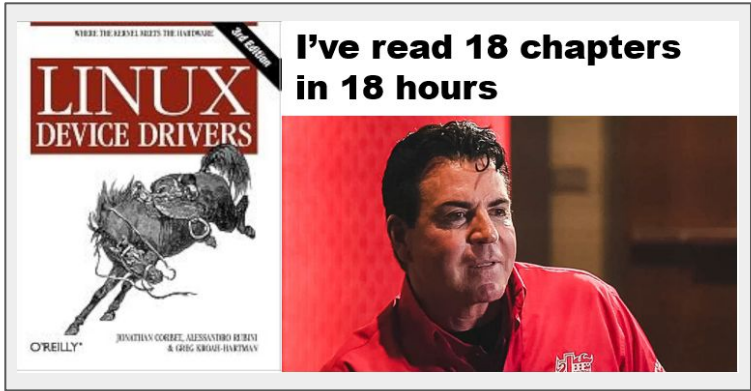
What did we learn?

Deep dive in building Linux Kernels, Petalinux, and cross compilation.

How Linux handles storage devices and uses them to make filesystems.

Driver development for block devices, and how to use IOCTL.

We hope our struggles can be used as a base for future groups that want to make a block device driver.



What would we have done differently?

Start with Linux 5.10 from the beginning, it has more examples and an API that is easier to understand.

Test with more kernels from different distros. We could have found out that the Xilinx one doesn’t work and planned around that better.

Implement more in PL to improve performance.