# Accessible Near-Storage Computing with FPGAs

Heterogeneous system architectures are considered vital for the ever-growing demand for computational power. However, data transfers between individual components of these increasingly complex systems impose a major bottleneck.

An upcoming mitigation strategy is to move compute resources close to places in the system, where data occurs naturally. The resulting increase in the diversity of compute resources raises the question how those resources can be made accessible to users and applications. This not only affects the programming model of near-memory compute kernels but also the practicalities of software development, including code portability, short iteration times and productive APIs.

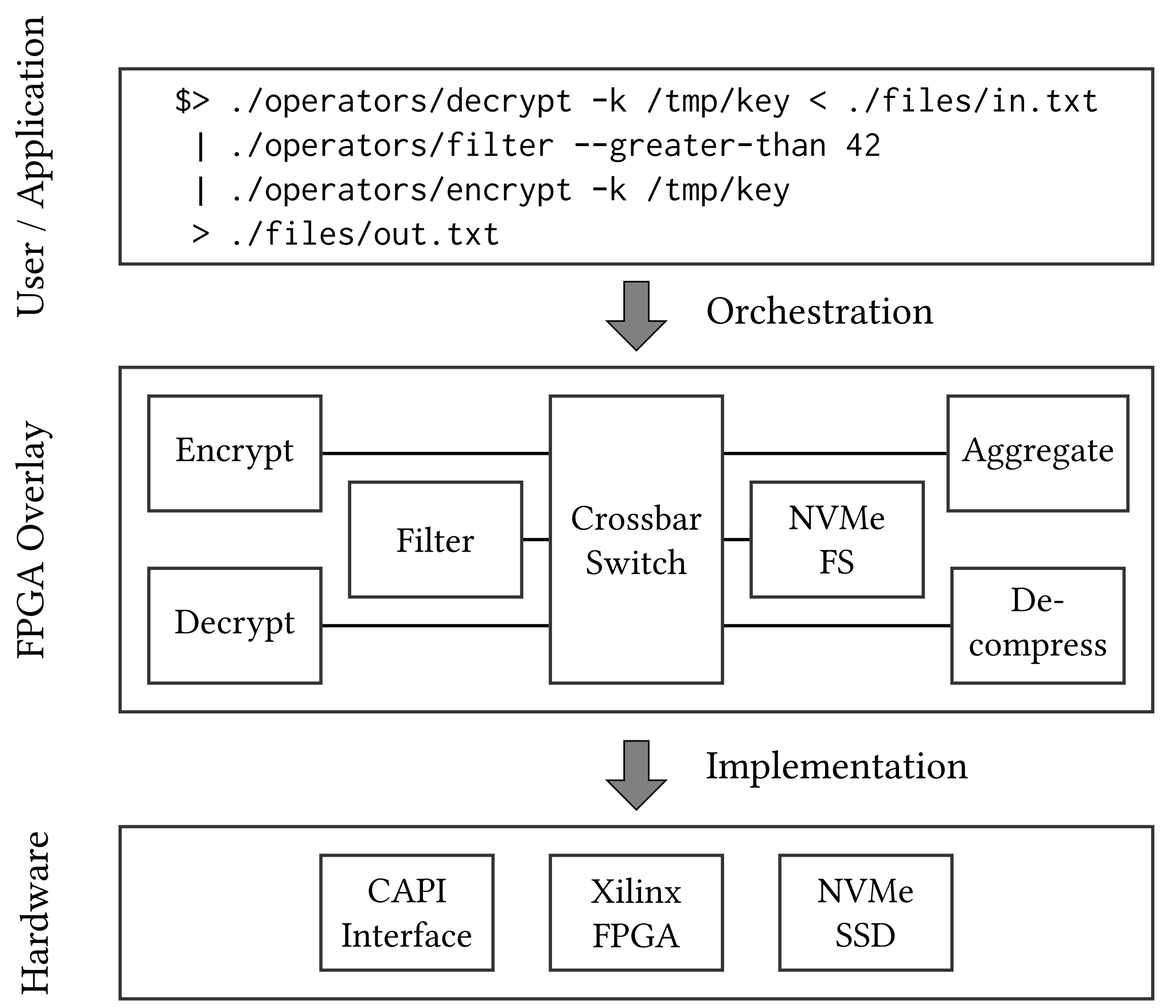
We introduce *Metal FS* as a framework that specifically targets combined FPGA+NVMe devices and improves the accessibility of such *near-storage compute* accelerators for users and developers in multiple ways.

Firstly, we argue that self-contained and reusable near-storage compute kernels operate on the granularity of file data streams; thus, we present a near-storage-compute-aware file system.

Secondly, we provide an integrated build process for FPGA overlay images that starts with the acquisition of previously defined compute kernels through a package manager and finally allows to dynamically configure near-storage compute pipelines consisting of such kernels.

Thirdly, we integrate the framework into Linux as a file system driver and repurpose Unix Pipes as a well-known operating system primitive to orchestrate near-storage compute pipelines.

MetalFS is open-source and available on https://github.com/osmhpu/metalfs.




```
void op_example(stream &in, stream &out) {
    stream_element element;
    do {
        element = in.read();
        // insert operator logic here
        out.write(element);
    } while (!element.last);
}
```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