



BoF: upstream drivers for open source FPGA SoC peripherals

- open source projects such as LiteX which have developed IP (e.g. chip-level hardware design) needed for building an open source SoC
- common workflow is that this SoC would be synthesized into a bitstream and loaded into a FPGA
- SoC design is done in a Hardware Description Language (HDL) with Verilog, VHDL, SystemVerilog or even newer languages (Chisel, SpinalHDL, Migen). This means we have the source and toolchain necessary to regenerate the design.



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- LiteX [\[1\]](#) is a good example of an open source SoC framework where it provides IP for common peripherals like DRAM controller, Ethernet, PCIe, SATA, SD Card, Video and more.
- key design decision for these peripherals are Control and Status Registers (CSR). The hardware design and the software drivers must agree on the structure of these CSRs.



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- Linux-on-LiteX-Vexriscv [2] combines the Vexriscv core (32-bit RISC-V), LiteX modules, and a build system which results in a FPGA bitstream, kernel and rootfs
- Linux kernel drivers for LiteX are currently being developed out-of-tree [3]
- LiteX SoC driver and LiteUART driver patch series from Mateusz Holenko of AntMicro is currently in v10 [4]



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- Earlier this year, support for Microwatt, a POWER-based core from IBM, was been added to LiteX by Ben Herrenschmidt
- Ben started a linux-litex thread of how best structure the LiteX CSRs and driver code for upstream [\[5\]](#)
- **Issue:** should drivers use CSR accessors or normal MMIO?
- **Issue:** should Linux drivers support 8-bit CSR or just 32-bit?
- **Issue:** how to describe what exists? Device tree overlays?



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- Martin Perens is developing LiteDIP [\[6\]](#):
"Plug-and-play LiteX-based IP blocks enabling the creation of generic Linux drivers. Design your FPGA-based SoC with them and get a (potentially upstream-able) driver for it instantly!"
- Martin wrote a blog post: "FPGA: Why So Few Open Source Drivers for Open Hardware?" [\[7\]](#)



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- [1] <https://github.com/enjoy-digital/litex>
- [2] <https://github.com/litex-hub/linux-on-litex-vexriscv>
- [3] <https://github.com/litex-hub/linux/commits/litex-vexriscv-rebase/drivers>
- [4] <https://lore.kernel.org/patchwork/project/lkml/list/?series=457681>
- [5] https://groups.google.com/d/msg/linux-litex/fJLIcsuBibY/3vP8_7nGAwAJ
- [6] <https://gitlab.freedesktop.org/mupuf/litedip/>
- [7] <https://mupuf.org/blog/2020/06/09/FPGA-why-so-few-drivers/>