IronForge for embedded Linux

IronForge builds the FPGA bitstream, the boot loader, U-Boot, Linux and the applications for AMD 7 series, UltraScale+, Zynq-7000 and Zynq UltraScale+ boards on a native Windows workstation. It needs no WSL, Linux virtual machine or container.

One command line drives AMD Vivado for the FPGA design, then cross-compiles the software and packages a root filesystem, SPI flash images and FIT images. Every board shares one source tree per component at locked versions: Linux 7.3.4, U-Boot 2026.10 and BusyBox 1.38.0. Each board adds its own FPGA design, drivers, device tree and flash layout. Boards boot from flash. On network-equipped designs, U-Boot can load the kernel and device tree over TFTP and Linux can mount a writable NFS root served from the Windows PC.

Processors and device families

IronForge covers soft processors in FPGA logic and hard Arm processors in SoC devices. The same commands, source versions and packaging steps serve each row.

Processor	Device families	Reference design	Similar boards and parts
MicroBlaze soft processor: 32-bit, MMU, caches, hardware multiply, divide and floating point	AMD 7 series FPGAs (Spartan-7, Artix-7, Kintex-7, Virtex-7) and UltraScale+ FPGAs (Artix, Kintex and Virtex UltraScale+)	Arty S7-50 (`XC7S50`), Arty A7-100T (`XC7A100T`) and Nexys Video (`XC7A200T`) run Linux on a 100 MHz MicroBlaze	Other 7 series and UltraScale+ parts and boards with external memory, such as the Arty A7-35T, Nexys A7, Genesys 2 and KCU116
MicroBlaze V soft processor: RISC-V instruction set	AMD 7 series and UltraScale+ FPGAs	Supported by a board port from a MicroBlaze reference design	The same boards as MicroBlaze
Arm Cortex-A9, one or two cores, with FPGA logic on the same device	AMD Zynq-7000 SoC, `XC7Z007S` through `XC7Z100`	Zybo Z7-20 (`XC7Z020`): Linux on both cores in 1 GiB of DDR3L	Other Zynq-7000 boards, such as the Zybo Z7-10, Arty Z7, Cora Z7, ZedBoard and MicroZed
Arm Cortex-A53, 64-bit, two or four cores, with FPGA logic on the same device	AMD Zynq UltraScale+ MPSoC	Supported by a board port	Zynq UltraScale+ boards, such as the ZCU102, ZCU104, Ultra96-V2 and Kria KV260
Arm Cortex-A7, 32-bit	ST STM32MP1	STM32MP157F-DK2 build profile	
ARM926EJ-S, 32-bit	Microchip SAM9X60	SAM9X60 Curiosity build profile	
Arm Cortex-A53, 64-bit (NXP)	NXP i.MX 8M Mini	i.MX8M Mini EVK build profile	
Altera FPGA and SoC FPGA processors	Altera	Roadmap	Roadmap

A reference design is the starting point for another board in the same device family. The port supplies the FPGA part, pin constraints, memory configuration, device tree and flash layout. The measurements in this brief apply to the four reference

> boards; a ported board is qualified on its own hardware.

FPGA reference designs

Board	What works on the board
Zybo Z7-20 Zynq-7000 `XC7Z020` two Cortex-A9 cores	Linux runs on both processor cores. IronVideo drives an HDMI console at 720p60, with 1080p60 as an engineering mode. IronCapture receives a Pcam 5C camera over two-lane MIPI CSI-2, and IronH264 streams 1080p30 H.264 Baseline over Gigabit Ethernet. The board plays stereo audio and reads FAT storage on microSD and USB. It boots from 16 MiB of QSPI flash with a bundled ramdisk, or loads the kernel and the FPGA design over TFTP and runs applications from the Windows NFS root.
Nexys Video Artix-7 `XC7A200T` MicroBlaze	IronVideo drives a physical HDMI monitor at 1280 × 720 and 60 Hz. U-Boot starts scanout and Linux displays the console or a centered game on `fb0`. The onboard OLED shows **IronKernel** on `fb1`. RTLNet provides Ethernet, and mpg123 plays stereo MP3 audio through ALSA and the onboard codec. IronVideo also passes full-frame simulation at 1920 × 1080 and 60 Hz.
Arty A7-100T Artix-7 `XC7A100T` MicroBlaze	A 100 MHz MicroBlaze runs Linux in 256 MiB of DDR3. A warm SPI boot reaches the shell in about 47 seconds from the loader banner. The default root filesystem runs in RAM, and files saved under `/data` survive reboot. EthernetLite supports the browser dashboard, MQTT and SSH. The serial console supports terminal games.
Arty S7-50 Spartan-7 `XC7S50` MicroBlaze	A 100 MHz MicroBlaze runs Linux in 256 MiB of DDR3L. JTAG supports bring-up. The standalone 16 MiB QSPI image cold-boots to a BusyBox shell on USB serial using an LZ4 RAM filesystem. A measured SPI restart took **20.45 seconds** from the first loader banner to the shell, including the five-second U-Boot countdown.

On the Zybo, the 1080p60 measurements apply to the tested board and display. On Nexys, the HDMI and OLED were confirmed together during a RAM boot. Warm SPI boot, network boot and persistent flash data have also been exercised on the board. The packaged SPI image for the display configuration has passed offline inspection. Each board has its own brief with the design, the boot flow and the measurements.

ARM build profiles

Platform	Available software
SAM9X60 Curiosity	Linux, U-Boot, BusyBox, NAND and SD bootstrap, peripheral demos, applications and games have passed software checks.
STM32MP157F-DK2	The toolchain, Linux, U-Boot and BusyBox have passed core software checks.
i.MX8M Mini EVK	The profile includes ARM64 cross-compilation, trusted firmware, DDR initialization and boot-image assembly recipes.

Roadmap

Altera FPGA support is on the roadmap. Send the device family and board when Altera support matters to your project.

Contact IronKernel

For IronForge integration, reference designs or custom development, send your target board and project goal. We offer AMD FPGA IP integration, U-Boot and Linux board bring-up, and driver development.
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