

Join the RISC-V Revolution

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Ubuntu Summit 2023



Canonical

Agenda

Applications

Containers

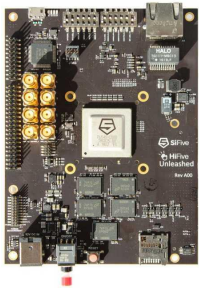
Virtualization

Boot Flow

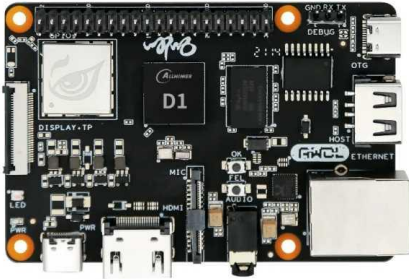
Hardware

Outlook

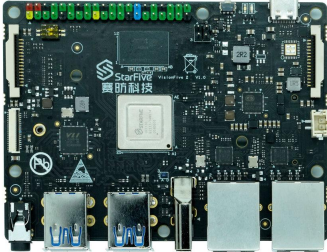
Ubuntu Hardware Enablement



2021



2022



StarFive
VisionFive 2

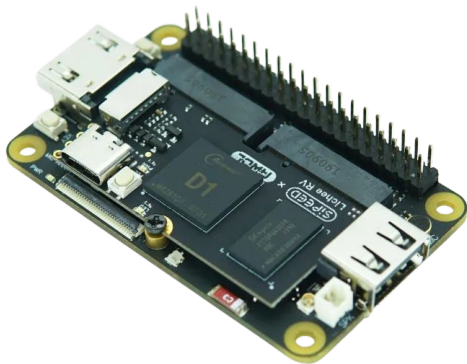
2023

Examples Of What You Could Buy Today For Ubuntu

Lichee RV Dock

ca. EUR 25

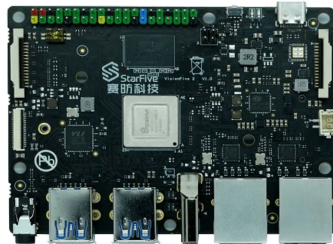
Ubuntu 22.04 and later
Single Core, only WiFi
Upstream Linux support
HDMI missing upstream



StarFive VisionFive 2 (1.3B)

ca. EUR 130

Ubuntu 23.10
4 Cores, NVMe, USB 3.0
Upstream Linux in progress
GPU only via vendor kernel
and close source blobs



Milk-V Pioneer Box

ca. EUR 2000

Ubuntu only via vendor image
Upstream kernel not usable
64 cores, 128 GiB RAM, PCIe



Ubuntu Desktop

Download Ubuntu desktop and replace your current operating system whether it's Windows or Mac OS, or, run Ubuntu alongside it.

[Get Ubuntu Desktop](#)

Ubuntu Server

The most popular server Linux in the cloud and data centre, you can rely on Ubuntu Server and its five years of guaranteed free upgrades.

[Get Ubuntu Server](#)[Mac and Windows](#)[ARM](#)[IBM Power](#)[s390x](#)

Ubuntu for IoT

Are you a developer who wants to try snappy Ubuntu Core or classic Ubuntu on an IoT board?

[Raspberry Pi](#)[Intel IoT platforms](#)[Intel NUC](#)[KVM](#)[Qualcomm Dragonboard 410c](#)[Intel IEI TANK 870](#)[AMD Evaluation kits & SOMs](#)[RISC-V platforms](#)

Ubuntu Cloud

Use Ubuntu optimised and certified server images on most major clouds.

[Get started on Amazon AWS, Microsoft Azure, Google Cloud Platform and more...](#)[Download cloud images for local development and testing](#)

TUTORIALS

If you are already running Ubuntu - you can [upgrade](#) with the Software Updater

Burn a DVD on [Ubuntu](#), [macOS](#), or [Windows](#). Create a bootable USB stick

READ THE DOCS

Read the official docs for [Ubuntu Desktop](#), [Ubuntu Server](#), and [Ubuntu Core](#)

OTHER WAYS TO DOWNLOAD

Ubuntu is available via [BitTorrents](#) and via a minimal [network installer](#) that allows you to customise what is installed, such as additional languages. You can also find [old releases](#)

UBUNTU FLAVOURS

Find new ways to experience Ubuntu, each with their own choice of default applications and settings.

[Eduubuntu](#)[Ubuntu Kylin](#)

CHOOSE A BOARD

- AllWinner Nezha
- Polarfire SoC FPGA Icicle
- QEMU emulator
- SiFive Unmatched
- Sipeed LicheeRV Dock
- StarFive VisionFive
- StarFive VisionFive 2**

StarFive VisionFive 2



Ubuntu Server
preinstalled image

[Download 23.10](#)

Ubuntu Server
live installer

[Download 23.10 live installer](#)

[How to install Ubuntu on the VisionFive 2](#)



Immutable Page

Info

Attachments

More Actions: ▾

Ubuntu Wiki

Login

Help

StarFive VisionFive 2

Board revision

Different revisions for the [StarFive VisionFive 2](#) board exists which use different device-trees. The board revision is silkprinted on the board. The Ubuntu image assumes that you are using revision v1.3B. If you are using board revision v1.2A, you will have to update the used device-tree as described below.

Updating U-Boot

For running Ubuntu you need U-Boot. The boot mode must be set to SPI flash (DIP switches RGPIO_0 = 0, RGPIO_1 = 0) as the Ubuntu image comes without U-Boot.

Vendor U-Boot releases are available at <https://github.com/starfive-tech/VisionFive2/releases/>. Or you can build U-Boot from the upstream source as described in the [online documentation](#).

As both for with some vendor U-Boot releases as well as with the upstream U-Boot v2023.10 we found some issues we have prebuilt a binary package u-boot-starfive available in <ppa:ubuntu-risc-v-team/release>.

You can extract the U-boot firmware files from the debian package with:

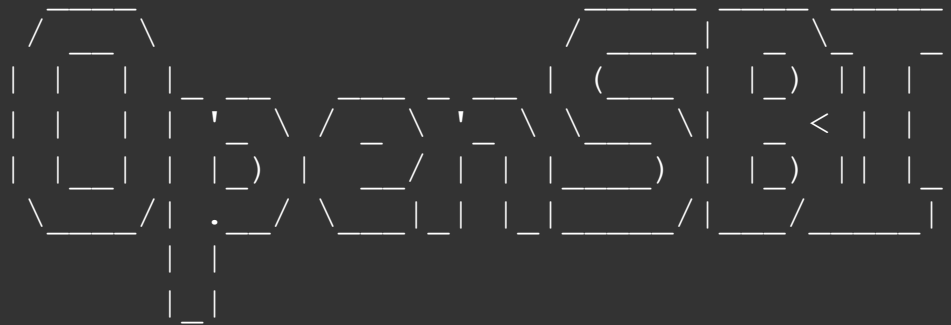
```
dpkg -x u-boot-starfive*.deb u-boot-starfive
find u-boot-starfive/
```

File u-boot-spl.bin.normal.out is U-Boot SPL. u-boot.itb contains the main U-Boot. (The vendor U-Boot releases call this file visionfive2_fw_payload.img.)

Updating U-Boot is described in https://doc-en.rvspace.org/VisionFive2/PDF/VisionFive2_OSG.pdf, chapter "3.8.1. Updating SPL and U-Boot of Flash".

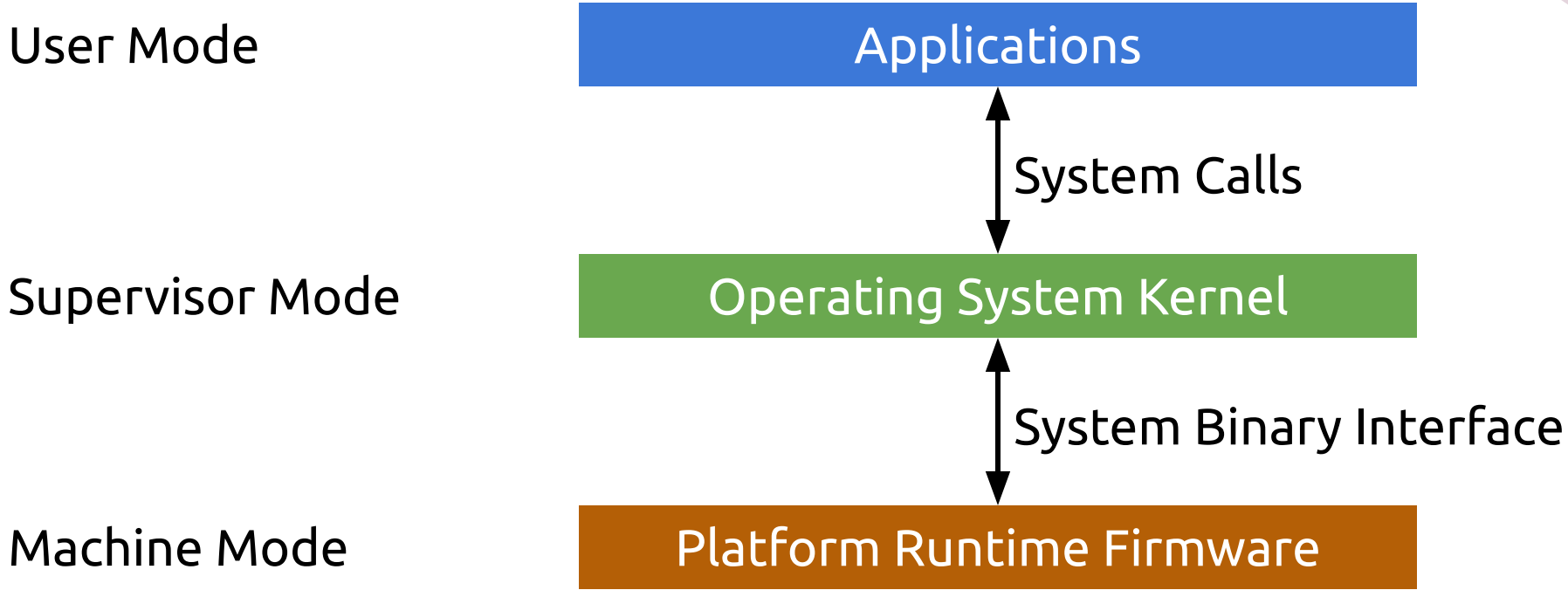


OpenSBI v1.3

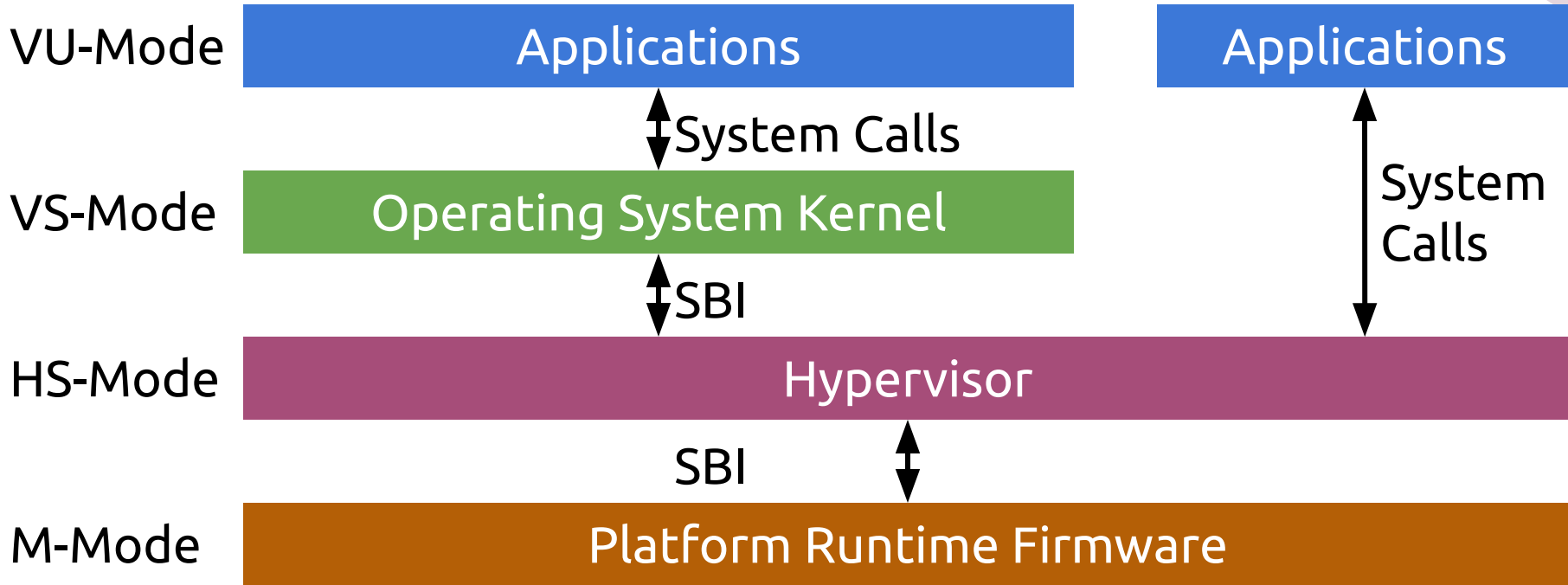


```
Platform Name           : riscv-virtio,gemu
Platform Features      : medeleg
Platform HART Count    : 4
Platform IPI Device    : aclint-mswi
Platform Timer Device  : aclint-mtimer @ 100000000Hz
Platform Console Device : uart8250
Platform HSM Device    : ---
Platform PMU Device    : ---
Platform Reboot Device : sifive_test
Platform Shutdown Device : sifive_test
Platform Suspend Device : ---
Platform CPPC Device   : ---
Firmware Base         : 0x80000000
```


RISC-V System without Hypervisor Extension



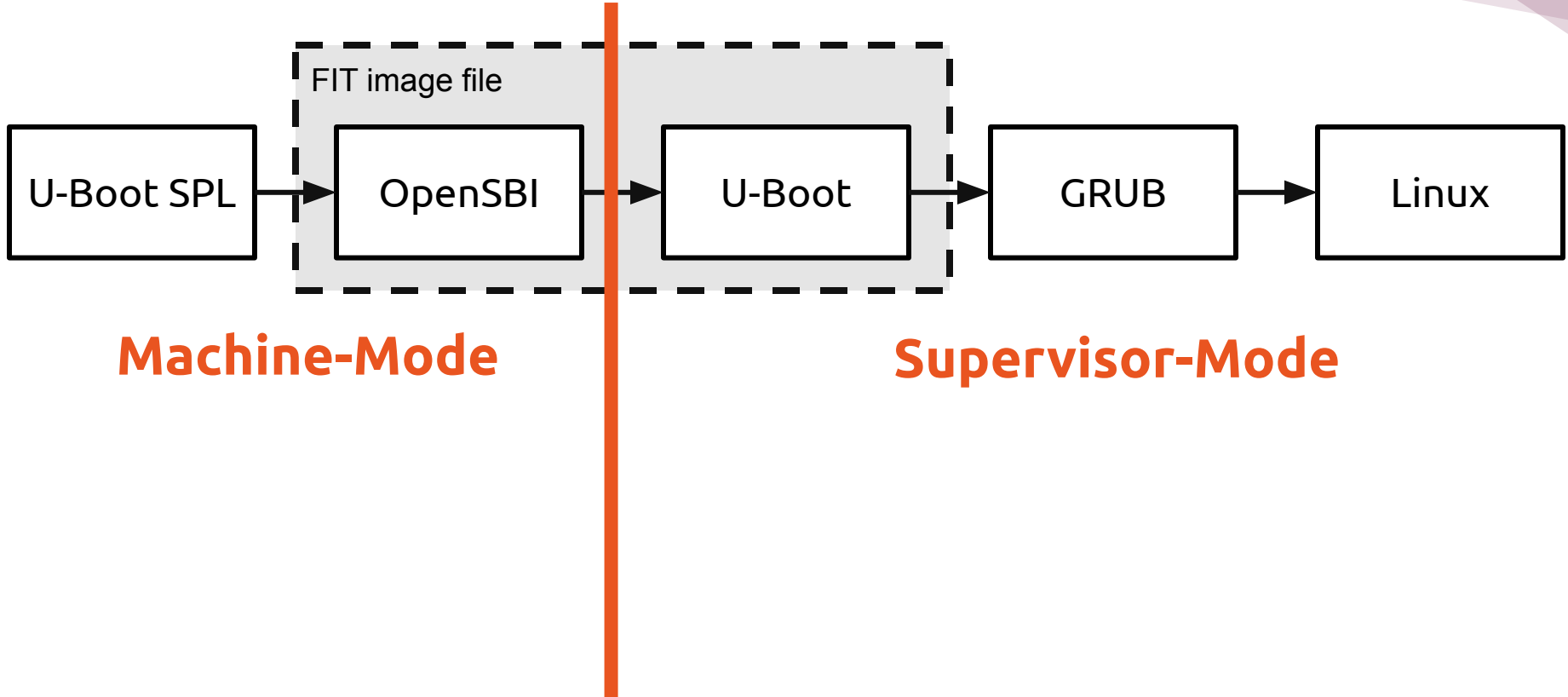
RISC-V System with Hypervisor Extension



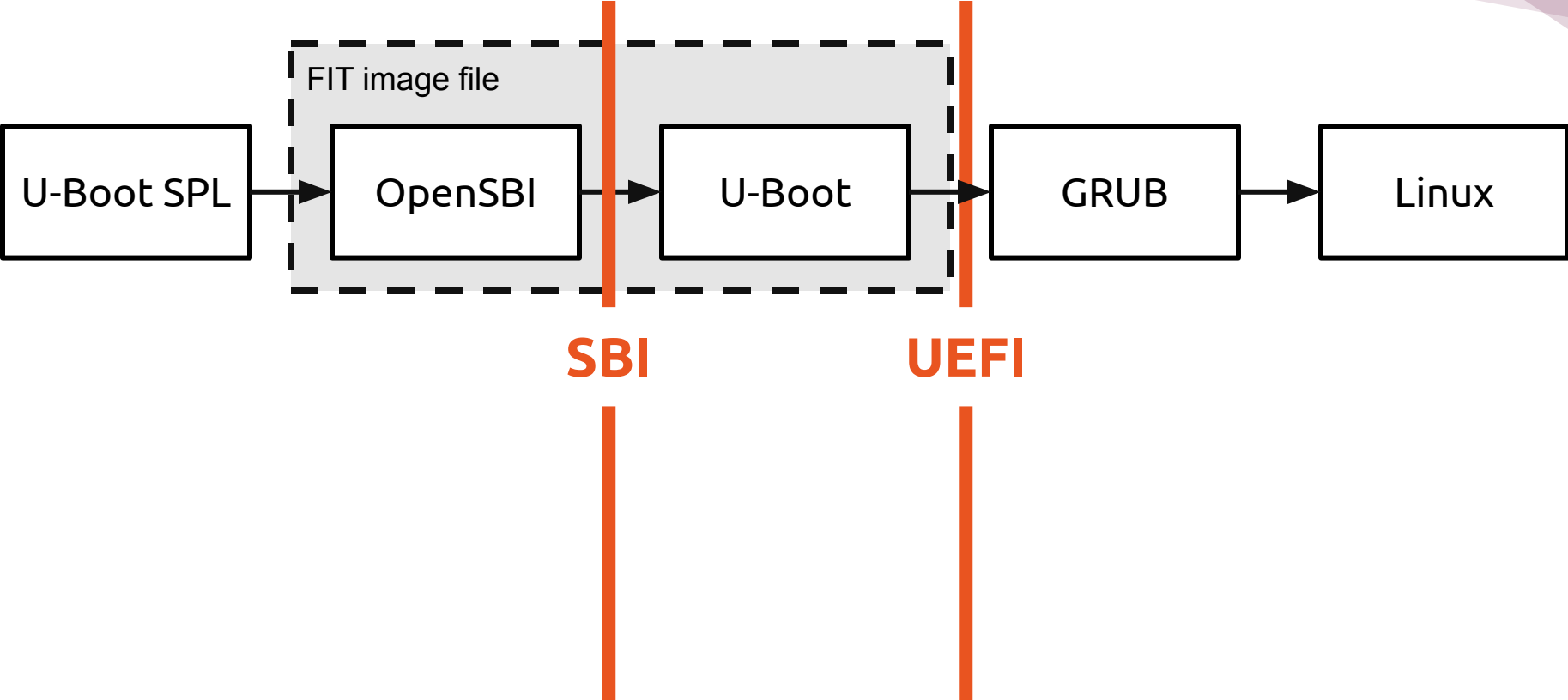
OpenSBI

- Handle unaligned access
- Emulate missing instructions
- Debug console
- System reset, suspend, poweroff
- Start/stop harts
- Performance counters
- ...

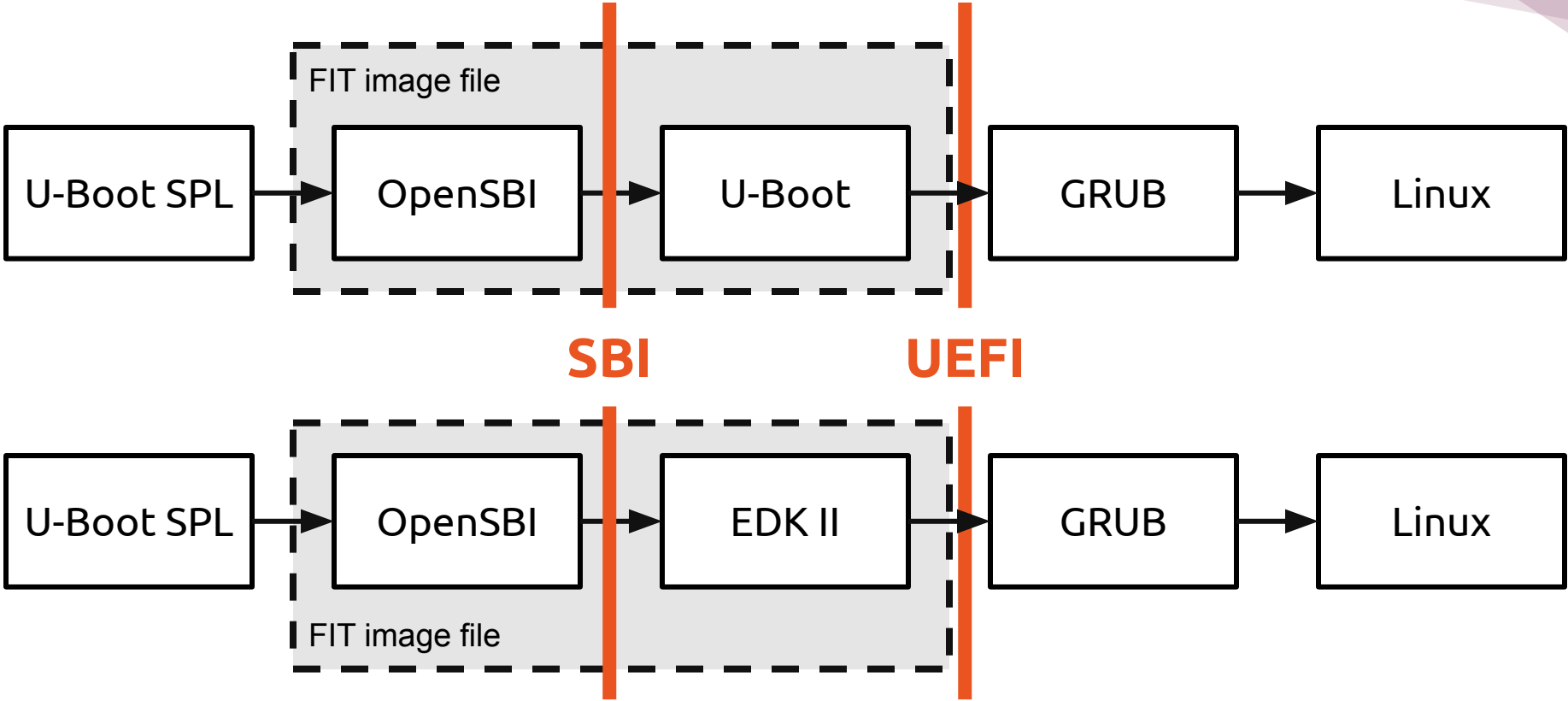
Boot Flow



Boot Flow

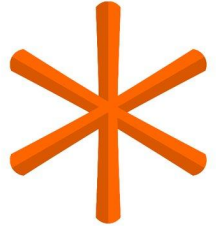


Boot Flow



EDK II

- EDK II provides a complete implementation of UEFI
U-Boot only provides the subset defined by EBBR specification
- StarFive, Sophgo provide EDK II for their systems
- Debian edk2 (2023.08-1) provides package
qemu-efi-riscv64
Requires QEMU >= 8.1



Running A RISC-V Virtual Machine On Your Laptop

```
sudo apt-get install opensbi qemu-system-misc u-boot-qemu  
qemu-system-riscv64 \  
-machine virt -nographic -m 8192 -smp 8 \  
-bios /usr/lib/riscv64-linux-gnu/opensbi/generic/fw_jump.bin \  
-kernel /usr/lib/u-boot/qemu-riscv64_smode/u-boot.elf \  
-device virtio-net-device,netdev=eth0 -netdev user,id=eth0 \  
-device virtio-rng-pci \  
-drive \  
file=ubuntu-22.04.3-preinstalled-server-riscv64.img,format=raw,if=virtio
```

Running A RISC-V Docker Image

```
sudo apt-get install docker-buildx qemu-user-static  
wget \  
https://partner-images.canonical.com/oci/mantic/current/ubuntu-mantic-oci-riscv64-root.tar.gz
```

```
cat > Dockerfile << eof  
FROM scratch  
ADD ubuntu-mantic-oci-riscv64-root.tar.gz /  
CMD ["bash"]  
eof
```

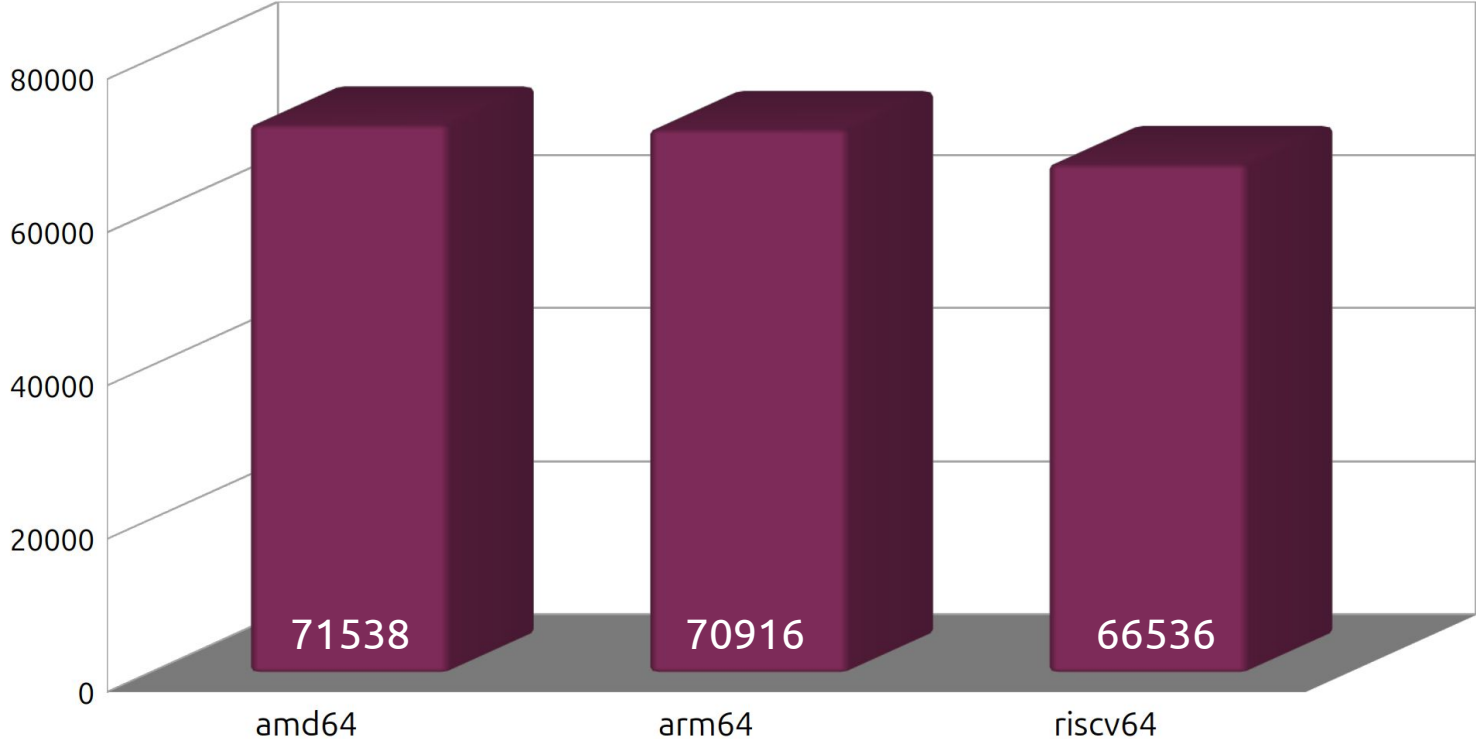
```
sudo docker buildx build -t mantic/riscv64:latest .  
sudo docker run -ti mantic/riscv64:latest
```

```
$ sudo docker run -ti mantic/riscv64:latest
root@9ae309710cc7:/# uname -a
Linux 9ae309710cc7 6.5.0-10-generic #10-Ubuntu
SMP PREEMPT_DYNAMIC Fri Oct 13 13:49:38 UTC 2023
riscv64 riscv64 riscv64 GNU/Linux
root@9ae309710cc7:/#
```

```
$ ps -aux | grep qemu
root 16349 0.0 0.0 221816 13500 pts/0 Ssl+
15:53 0:00
/usr/libexec/qemu-binfmt/riscv64-binfmt-P
/usr/bin/bash bash
```

State Of The Software Eco-System

Ubuntu 23.10 Binary Packages



as of 2023-10-16



OpenJDK



GO C



~~.net~~



LXD

Building Your Own Software

```
apt-get update
```

```
apt-get install debhelper-compat gnulib help2man \  
texinfo ubuntu-dev-tools
```

```
pull-lp-source hello mantic
```

```
cd hello-2.10/
```

```
dpkg-buildpackage
```

```
dpkg -i ../hello_2.10-3_riscv64.deb
```

```
hello
```

Building A RISC-V Snap In Your VM Or On RISC-V HW


```
sudo snap install snapcraft --classic
lxd init --auto

git clone \
https://git.code.sf.net/p/sispmctl/git sispmctl

cd sispmctl/

snapcraft --use-lxd

sudo snap install sispmctl*.snap --dangerous
```

Launchpad Support

Processors: (Optional)

- AMD x86-64 (amd64)
- ARM ARMv8 (arm64)
- ARM ARMv7 Hard Float (armhf)
- Intel x86 (i386)
- PowerPC (powerpc)
- PowerPC64 Little-Endian (ppc64el)
- RISC-V 64-bit (riscv64)
- IBM System z (s390x)

RISC-V is supported for building packages and snaps.

Public availability in PPAs expected soon.

Outlook

Profiles

Profile	RVA20	RVA22	RVA23
Mandatory	M multiplication, division A Atomic instructions F Single-precision FP D Double-precision FP C Compressed instructions Zicsr CSR instructions Zicntr, Ziccif, Ziccamao, Za128rs, Zicclsm	Zihintpause Pause instruction. Zba Address computation. Zbb Basic bit manipulation. Zbs Single-bit instructions. Zicbom, Zicbop, Zicboz Cache Management Zfhmin Half-Precision	H The hypervisor extension V Vector Extension Zjpm Pointer masking <i>many more</i>
Optional	Zihpm Hardware perf counters	Zkt data indep execution time H The hypervisor extension V Vector Extension Zfh Half-Precision FP Zkn Scalar Crypto NIST Zks Scalar Crypto ShangMi	Zvkng Vector Crypto NIST Zvksg Vector Crypto ShangMi Zvfh Vector FP16 <i>many more</i>

What Ubuntu 23.10 Is Built For

```
gcc -dumpspecs
```

- `march=rv64imafdc_zicsr_zifencei`
This is close to RVA20.
- `mabi=lp64d`

```
readelf -A filename
```

```
Attribute Section: riscv
```

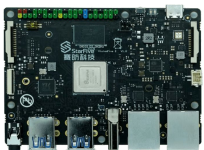
```
File Attributes
```

```
Tag_RISCV_stack_align: 16-bytes
```

```
Tag_RISCV_arch:
```

```
"rv64i2p1_m2p0_a2p1_f2p2_d2p2_c2p0_zicsr2p0_zifencei2p0_zmmul1p0"
```

Hardware vs RISC-V Profiles



≤ RVA20

Milk-V Oasis
Sophgo 2380
SiFive P670/X280
RVA22
+Vector
+Virtualization

RVA22



RVA23

How Can Upstream Software Adapt To Extensions

- Detect available extensions at runtime
 - Linux kernel provides the RISC-V Hardware Probing Interface syscall
- Provide alternative code paths depending on the extension set.
- GNU indirect functions (ifunc) can be used for this purpose.

```
#include <stdio.h>
#include <time.h>

static void test1(void) {printf("%s: odd\n", __func__)}
static void test2(void) {printf("%s: even\n", __func__)}

static void (*resolve_test(void))(void) {
    time_t t;

    printf("%s\n", __func__);
    if (time(&t) & 1)
        return test1;
    else
        return test2;
}

void test(void) __attribute__((ifunc("resolve_test")));

int main() {
    printf("%s\n", __func__);
    test();
    return 0;}

```



```
$ ./test  
resolve_test  
main  
test1: odd
```

```
$ ./test  
resolve_test  
main  
test2: even
```

How Can Ubuntu Adapt To Changing Profiles

Install alternative package builds depending on system

- Already feasible today:
Alternative archive/ppa + apt pinning
- Under investigation:
Enable apt to install alternative package builds

Raise the base profile of future releases

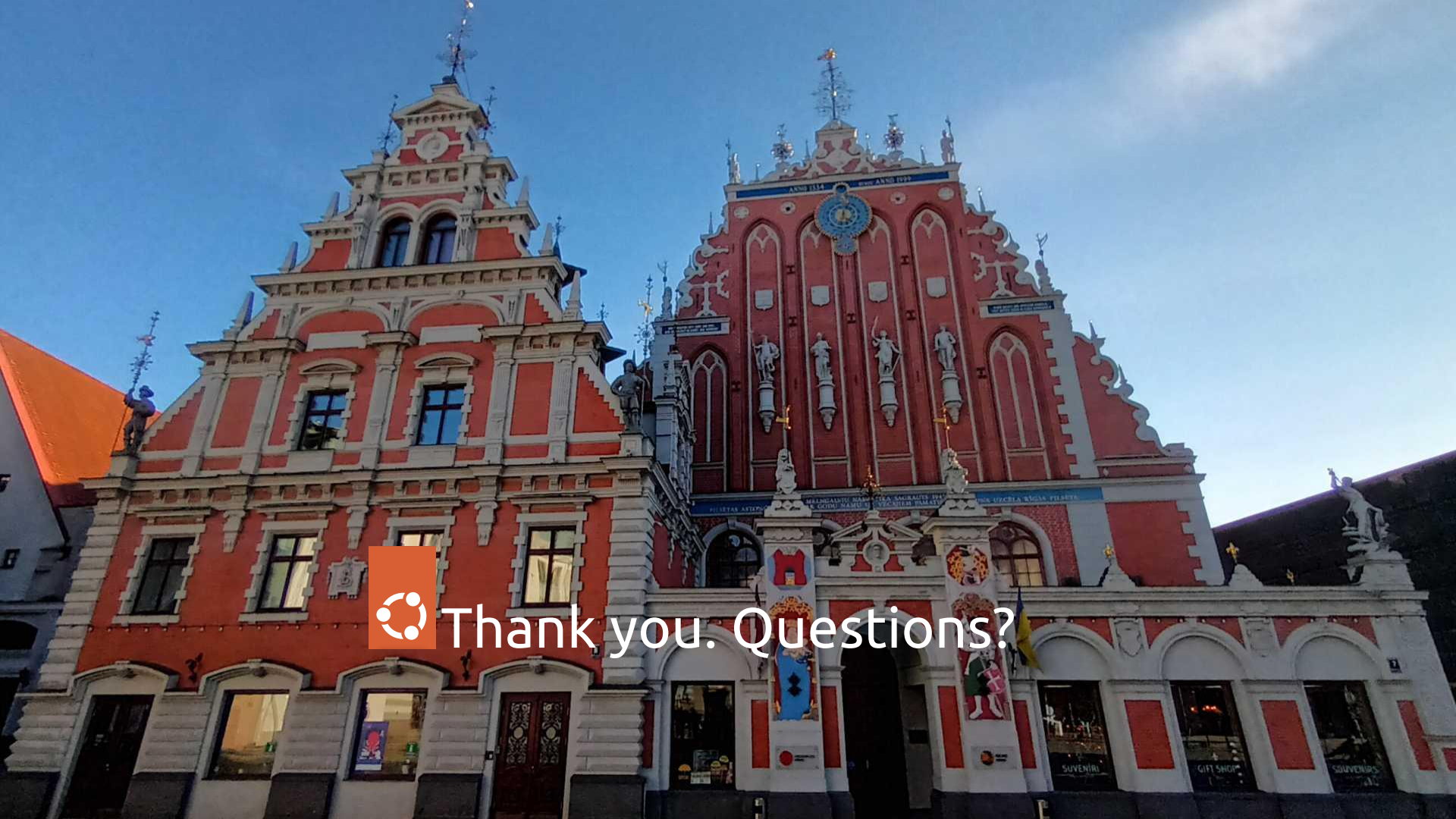
- Nothing decided yet. Depends on market development.

Next to Come

Ubuntu 23.10 planned to be available
on the SiFive HiFive Pro P550 at its launch.

<https://www.sifive.com/boards/hifive-pro-p550>





Thank you. Questions?

SUVENIRI

GIFT SHOP

SUVENIRS